THE DENTAL PRACTITIONER

AND DENTAL RECORD

Including the official reports of the British Society of Periodontology, the British Society for the Study of Orthodontics, the European Orthodontic Society, the Liverpool and District Odontological Society, the North Staffordshire Society of Dental Surgeons, the Odonto-chirurgical Society of Scotland, and the Dental and Medical Society for the Study of Hypnosis

VOL. VI, No. 12 August, 1956

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AND DENTAL RECORD

Vol. VI, *No.* 12 *August*, 1956

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EDITORIAL

ANTIBIOTICS

THE years since the conclusion of the second world war have brought with them such astonishing, and to the ordinary citizen, incomprehensible and terrifying advances in the scientific field, that the mind is numbed in the attempt to understand their significance and the possible effects on everyday life in the future.

Dentistry, in common with all other branches of medicine, has benefited from these developments; research methods have greatly improved with the availability of such aids as the electron microscope and radio-active isotopes; the application of tomographic methods to the radiological study of the temporomandibular joint; the continued improvement and development of the plastic resins, particularly in the field of restorative dentistry. These are but a few of the ways in which science has helped the dentist. With such great expectations, disappointments were perhaps inevitable, and perhaps the greatest disappointment has been the realization that the antibiotic drugs have not yet produced the final solution to the problem of the control of infectious disease. Their value in the treatment of oral infections cannot logically be disputed, although some experienced workers have recently challenged the claims of the protagonists of antibiotic endodontic therapy. The possibility of sensitization against an antibiotic which might make its later administration ineffective or even dangerous in the case of a serious infective condition arising, is one of the many arguments against indiscriminate use of these drugs in root therapy.

The review of the use of antibiotics in root-canal therapy published in this issue examines the subject fully and exhaustively. It should assist the dental surgeon to approach his own problem less empirically. Before deciding that an antibiotic is the drug of choice in treatment of any condition he should consider very carefully whether there is any alternative method of treatment which might be equally effective without the possibility of producing undesirable side-effects.

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THE USE OF ANTIBIOTICS IN ROOT-CANAL THERAPY*

By **Professor JOHS. JUUL HOLST,** COPENHAGEN

I HAVE chosen this subject for my lecture because in my department of the Royal Dental College of Copenhagen we have been working on the improvement of the treatment of infected root canals for a couple of years.

We were and we still are absolutely convinced that many factors other than the antibacterial remedy itself are of great importance in trying to get the best possible results in the treatment of non-vital teeth. This applies to the mechanical preparation of the root canal and to the root-canal filling, just to mention two such factors. But this admission should not let us be deterred from looking out for new and better remedies helping us to control the bacteria in the root canal of non-vital teeth.

For many years we have been using various chlorine derivatives in the treatment of infected root canals in the department of restorative dentistry of the Royal Dental College of Copenhagen. Just before the war we tried to after-examine 2000 patients who had had root-canal work done 3–8 years before the calling in. Only 311 patients appeared for the after-examination, with 416 cases of root-canal treatment, 292 cases with vital pulps, and 126 cases with non-vital pulps. We examined the cases for clinical symptoms and for roentgenological symptoms. The results of our treatment of the cases with vital pulps were satisfactory. We registered 247 cases, or 84·6 per cent, as successful; 22, or 7·5 per cent, as dubious; and only 23, or 7·9 per cent, as failures. But we were shocked after examining the cases with non-vital pulps: Of the 126 cases only 60, or 47·6 per cent, were marked as successful; 44, or 34·9 per cent, were dubious; and 22, or 17·5 per cent, were direct failures. I will not enter into a discussion of these figures to-day to explain the very unsatisfactory results of our treatment at that time. This experience taught us, however, to be very careful in selecting cases with non-vital pulps for root-canal treatment, and subsequently we have been on the look-out for new and better remedies in root-canal work.

I will never forget a lecture that in the happy days just after the liberation of Denmark by our brave allies in May, 1945, was given by a British officer of the R.A.F. in Copenhagen on the use of the famous penicillin in the treatment of the endemic acute necrotic gingivitis which at that time was a great problem in Denmark too. After the lecture I was presented with a glass jar containing the mysterious lozenges that were able to relieve the suffering patient almost instantaneously of his pains. Neither will I forget the lecture given by Sir Alexander Fleming in, I think, 1945 in the festival hall of the Copenhagen University on penicillin. Sir Alexander concluded his lecture by saying that no doubt other antibiotics will appear, but if anything is going to beat penicillin it must be "damned good".

Time has shown how right Sir Alexander was in his statement.

Please remember that at that time we did not know much of what happened in the new field of antibiotics in Great Britain and the U.S.A. We had for five years been completely cut off and had only had scarce copies of periodicals smuggled in from Sweden, but after the liberation we soon learnt that even dentistry might benefit from the use of antibiotics.

It is not my intention on this occasion to dilate on the great expectations of penicillin in the treatment of the acute necrotic gingivitis or on the bitter disappointments that followed. Nor is it my intention to dwell on the history of antibiotics in root-canal treatment, but I cannot help stating a few

* A lecture delivered to the Odonto-Chirurgical Society of Scotland on Thursday, February 9, 1956.

facts, and, first, that dentistry was on the alert in this respect, too, when antibiotics came up. As early as 1944 two Americans, Cipes and Smith, independent of each other, stated that penicillin and tyrothricin might be used in root-canal treatment, and Adams advocated in 1944 the flushing of infected root canals with a solution of penicillin containing 5000 i.u. per c.c. Shaw, Sprawson, and May used penicillin as a dressing, each paper-point containing 50 Oxford units. The results were not satisfactory, they only got 1 negative culture out of 23 cases. Very soon better results were obtained by using higher doses of penicillin. Potkin in 1946 used 500 i.u. and got 3 negative cultures out of 24 cases. Cipes used 500 i.u., too, and Grossman 650 i.u. Stewart raised the dose to 10,000 i.u. and Bender in 1947 used as high a concentration as 50,000 i.u. per c.c. and used 1 c.c. in each sitting.

In 1948 the situation was thus that although the concentrations of penicillin used were still rising, or better jumping up, the results were rather discouraging. Much work was performed to find out why penicillin failed in a number of cases.

Crowley and Harner in 1947 examined several strains of streptococci isolated from infected root canals. They found that although the common green streptococci were sensitive in 90 per cent, both the hæmolytic streptococci and the γ streptococci were only sensitive to penicillin in 10 per cent.

Tuluck and Tilden described the results of bacteriological studies on material from infected root canals and found that of 28 strains of streptococci 6 strains were resistant to penicillin. These were enterococci and they found penicillin-resistant lactobacilli too. Grossman found in 200 cases of infected root canals 14 cases with penicillin-resistant micro-organisms, including *Pseudomonas aeruginosa*, *Bacillus subtilis*, and *Escherichia coli*.

Ostrander concluded as early as 1947 that as so relatively many penicillin-resistant bacteria were found in infected root canals and as a sufficient bacteriological control could not be carried out in usual clinical practice, penicillin could not be advocated as a reliable antibacterial remedy in dental practice. In Copenhagen we came to the same conclusion. Not only did we find a certain number of cases with penicillin-resistant bacteria, but we even found that in some cases that showed negative cultures either at the beginning of the treatment or at a later stage, after a while, we got positive cultures in spite of the continued treatment with penicillin. Some of these cases showed penicillin-resistant staphylococci or streptococci and some of them yeasts that we could identify as *Candida albicans*. This penicillin-resistant fungus was found in cases of infected root canals treated with antibiotics as early as in 1945 by Bartels and Buchbinder, and it is no exaggeration to state that the presence of this fungus still is one of the crucial points of antibiotics in root-canal work.

The great expectations of penicillin as a panacea in the treatment of infected root canals were thus not fulfilled and other antibiotics were tried out.

Tyrothricin was used, as we did in Copenhagen in combination with a quaternary ammonium salt, cetyl-pyridinium chloride, but the results were not satisfactory, possibly owing to the inhibitory effect of residues of organic tissue or small amounts of serum in the root canal.

Streptomycin was tried by Bartels and Buchbinder, but although it proved to be effective in cases with a penicillin-resistant flora it was not sufficiently effective towards the most common Gram-positive micro-organisms.

Terramycin, or oxytetracycline, was produced, in 1950 by Finlay. We started using it in 1951, both alone and in combination with tyrothricin. Our expectations of terramycin were high because of its broad spectrum of activity, and we still use terramycin in selected cases. I will come back to this point later. We got rather good results: of 24 cases we found in 18 cases, or 75 per cent, negative cultures after two treatments.

Soul got better results when he used high concentrations of terramycin. Of 28 cases he got negative cultures in 23 cases, or 82 per cent. He used approximately 100 mg. terramycin as a dressing between sittings.

Aureomycin and chlortetracycline have been used, too, but rather seldomly and with no better results than terramycin.

To my knowledge none of the newer antibiotics with a broad spectrum of activity has proved sufficiently effective when used alone.

It lay, however, near at hand to utilize the specific effectivity of the different antibiotics in using them in combination, as a strain of bacteria resistant towards one antibiotic is not likely to be resistant against another antibiotic with a different spectrum of activity. Furthermore the combination of two antibiotics might not only yield an additive effect, a synergistic effect might be possible, as Bachman has shown for the combination of penicillin and bacitracin.

In 1949 Grossman published the results of treating infected root canals with a combination of penicillin and streptomycin. He used 50,000 i.u. of penicillin and 500 mg. streptomycin in 1 c.c. of pea-nut oil. He succeeded in obtaining negative cultures in 135 cases of 150 treated cases, or in 90 per cent.

Seltzer and Bender could not obtain any effect of a combination of penicillin and streptomycin on enterococci and advocated instead of streptomycin the use of chloramphenicol (chloromycetin.) In 1951 they advocated, however, a combination of 300,000 i.u. penicillin, 200 mg. chloramphenicol, 250 mg. streptomycin, and 250 mg. sodium caprylate. They succeeded in obtaining negative cultures in 95 per cent of the cases treated after one treatment.

Grossman recommends his poly-antibiotic paste consisting of 1 mega unit or 1,000,000 i.u. or 60 g. sodium benzylpenicillin, 10,000 i.u. bacitracin, 1 g. dihydro-streptomycin, and 1 g. sodium caprylate in 3 c.c. silicone D.C. 200 of a viscosity of 3–30 centistokes. Grossman has tested the different remedies in his poly-antibiotic paste towards streptococci, enterococci, staphylococci, *Escherichia coli*, and *Candida albicans* and has found that penicillin is active against streptococci, bacitracin against staphylococci and enterococci, streptomycin against *Escherichia*, streptococci and staphylococci, and sodium-caprylate against *Candida albicans* and to some degree against all the bacteria mentioned.

His clinical results are the best published heretofore. Of 250 treated cases he got negative cultures in 162 (65 per cent) after one treatment, in 233 cases (93 per cent) after two treatments, and in only 17 of the 250 cases were three or four treatments necessary.

In Copenhagen we followed, for obvious reasons, the development of the use of antibiotics in root-canal therapy very closely. For reasons to be discussed later we did not want to use the newer antibiotics with the broader spectra of activity unless absolutely necessary, and accordingly after our failures with the use of penicillin we fell back on our old method of using chlorine derivates as antibacterial remedy and tested our clinical work with bacteriological cultures. We collected our records and found that in approximately 85 per cent of the cases we were able to get negative cultures in this way. Of course we did our best to avoid contamination and to work aseptically, and we stressed the necessity of a very careful and sufficient mechanical preparation of the root canal itself and of frequent flushing of the field with the disinfectant solutions, a 2 per cent solution of chloramine. Between sittings we placed paper-points impregnated with a 10 per cent solution of dichloramine-T in pentachlorethane in the root canals. With this preparation we got a more prolonged effect of chlorine than we could obtain with the usual aqueous solution of chloramine, which in the presence of organic matter is very unstable.

Our first series, *Series A*, consisted of 108 cases with non-vital pulps. For various technical reasons 13 cases were excluded from the series. Of the 95 cases left we found 28 cases (30 per cent) with negative cultures at the second sitting, 57 cases (60 per cent) at the third sitting, 70 (73 per cent) at the fourth sitting, and 77 (81 per cent) with negative cultures at the fifth sitting. After four treatments we thus got negative cultures in 77 cases (81 per cent) of the original 95 cases. We tested the cultivable organisms from the cases that showed positive cultures at the fourth and fifth sitting for sensitivity towards

different antibiotics and one sulphonamide, and the cases that continued giving positive cultures after the fifth sitting were treated with the antibiotic that showed the most pronounced antibacterial effect—i.e., the largest inhibitory zone on the test plates.

At this time we changed our culture media from the Crowley medium to a similar medium containing sodium thioglycollate and we collected a new series of reports, *Series B*. We did not, however, change the standard technique used in treatment of the cases.

Series B deals with 480 cases, of which 63 were excluded for various technical reasons, and 98 cases that showed negative cultures at both the first and second sitting were excluded from the series too.

Of the 319 cases left, 136 (43 per cent) showed negative cultures at the second sitting, 192 (60 per cent) at the third sitting, 252 (79 per cent) at the fourth sitting, and 270 (85 per cent) at the fifth sitting; 49 (15 per cent) still showed positive cultures after four treatments. From all cases that had shown positive cultures at the third and fourth sitting sensitivity tests towards different antibiotics were made, and the 49 cases that continued showing positive cultures after the fifth sitting were treated with antibiotics according to the results of the sensitivity tests.

The similarity of the results in *Series A* and *B* is striking. The number of cases treated should warrant the validity of the statement that our standard root-canal treatment of that time would yield approximately 85 per cent cases with negative cultures, but that in 15 per cent we were not able to obtain negative cultures from the root canal by our standard technique. We simply had to supplement our treatment in some other way, and consequently we used different antibiotics as suggested by the sensitivity tests.

This time-wasting treatment was somewhat improved when we decided that in all cases that did not show negative cultures at the second sitting sensitivity testing should be made simultaneously with the continued treatment. We could, however, hardly recommend such a treatment for general practice where one has not got the outfit for making cultures and sensitivity tests, and we could no longer recommend our usual standard technique for clinical treatment of infected root canals when the bacteriological examination had shown that we could in only 85 per cent of the cases produce negative cultures by this method.

At that time, in 1953, a new combination of antibiotics, prepared for topical use only was advocated by Szabo and co-workers. It was called nebacetin from its two constituents, neomycin and bacitracin. Neomycin is an antibiotic substance derived from *Streptomyces fradiæ* by Waksman and Lechevalier in 1949. It has a strong bactericidal effect, especially on Gram-negative bacteria, but to some degree on most Gram-positive bacteria, too, its spectrum resembling that of streptomycin. Bacitracin was first described by Johnson and co-workers in 1945. It was derived from *Bacillus licheniformis*. Its activity spectrum resembles that of penicillin, only it is broader, including enterococci and clostridia.

The combination of neomycin and bacitracin as in nebacetin augments the antibacterial effect more than is counted for by simple addition of the antibacterial effect of each component. Apparently the augmented effect is due to a real synergism between the two components. Both neomycin and bacitracin have a very low allergy index, and acquired resistance is practically never found.

Both neomycin and bacitracin are toxic substances, neomycin having oto- and nephrotoxic effects and bacitracin nephrotoxic effects. Accordingly they are never or only very seldomly used in general antibiotic treatment. Used topically they are practically not absorbed and they produce no local irritation of the skin and of the mucous membrane.

Several reports on the local use of nebacetin in dermatology, ophthalmology, and otology have been published, with as a whole, a satisfactory effect.

Having tested the sensitivity of a number of different strains of micro-organisms from infected root canals, and having made some pilot experiments using various concentrations of nebacetin in an aqueous solution, we started letting the students use a 10 per cent solution

of nebacetin containing 50 mg. neomycin and 50 mg. bacitracin per c.c. in the treatment of infected root canals.

Series C. Having tried the treatment in 36 cases of non-vital pulps we gave it up as the results were very poor. Of the 36 cases treated, 5 were excluded for various reasons. Of the 31 cases left, we succeeded in getting negative cultures in only 16 cases (52 per cent) even after five treatments, and most remarkable was the extremely small number of negative cultures at the second sitting, only 2 cases (6 per cent) out of 31 cases treated. After five treatments 48 per cent still showed positive cultures and had to be treated otherwise. This poor result puzzled us, as the surviving bacteria from the treated canals in the laboratory all showed marked sensitivity to the same 10 per cent solution of nebacetin.

We discussed this astonishing result with both bacteriologists and biochemists, and they advocated adding a wetting agent to the solution of nebacetin. We did not dare to take another risk of releasing the use of nebacetin to the students, but the instructor in root-canal treatment tried the new nebacetin solution in 40 cases with non-vital pulps (*Series D*). Of these cases 13 were excluded as they showed negative cultures at both the first and second sittings. The response to the treatment was surprisingly good. After one treatment with the nebacetin solution, as the only remedy used, we got negative cultures in 50 per cent, after two treatments in 93 per cent; and the 2 remaining cases showed negative cultures, one after the fourth and the other after the fifth treatment.

We had not, however, forgotten our discouraging results in the group of cases in *Series C* treated by students with the first nebacetin solution, and we decided therefore to try to enhance the effect of the nebacetin by using a suspension of nebacetin in silicone as a dressing between sittings.

The idea was that this suspension should act as a nebacetin-depot, from which nebacetin should be slowly liberated.

We chose silicone because Grossman had advocated silicone as a vehicle in his poly-antibiotic paste. In order to run no risk in releasing the nebacetin too early for use by students the instructor again carried out a series of treatments using the nebacetin suspension as the only antibacterial remedy. The root canals were flushed with sterile water during the mechanical cleansing and preparation of the canal and after drying the root canal with absorbent points the nebacetin suspension was rotated into the canal with a Lentulo spiral (*Series E*). The results were most satisfactory and so far astonishing as no antibacterial remedy was used during the sittings. Most astonishing, however, was the almost identical antibacterial effect of the aqueous solution of nebacetin and of the nebacetin suspension in silicone.

Of the 34 cases treated 5 were excluded for various technical reasons, and of the 29 cases left 18 cases (62 per cent) showed negative cultures after one treatment, and 26 cases (90 per cent) after two treatments. In the remaining 3 cases negative cultures were obtained at the fourth or fifth sitting.

We then released the use of nebacetin again and the students were instructed to use the 10 per cent nebacetin solution for flushing the root canal during the mechanical cleansing and preparation of the root canal and the nebacetin suspension as a dressing between sittings. *Series F* shows the results of this treatment in 137 cases of non-vital pulps treated by students; 7 cases were excluded for various technical reasons and 34 cases showed negative cultures at both the first and second sitting. Of the 96 cases left, 63 cases (66 per cent) showed negative cultures when the inoculation was made at the second sitting; 84 cases (88 per cent) showed negative cultures at the third sitting; and 90 (94 per cent) at the fourth sitting. Only in 6 cases (6 per cent) we did not succeed in getting negative cultures.

As the technique using the nebacetin suspension was rather difficult and as we thought that the small number of failures might possibly to some extent be due to insufficient sealing of the canals between sittings because of the suspension we have recently changed our method again. First we tested the bacteriostactic effect of paper-points

impregnated with the aqueous nebacetin solution that had been left in root canals for various lengths of time on 24-hour-old cultures on our usual test organism (staphylococcus No. 1010). We found no reduction in the inhibitory zone even after 41 days. We then omitted the nebacetin suspension completely and are now using the 10 per cent aqueous nebacetin solution as the only antibacterial remedy. To this solution is added 0·5 per cent between 60 as a wetting agent and 0·1 per cent methyl-propyl-para-oxybenzoate as a fungicide.

We have for this occasion collected 47 recently treated cases (*Series G*). Of these 47 cases 5 cases had to be excluded for various technical reasons and 8 cases showed negative cultures at both the first and second sitting. Of the 34 cases left, 26 (76 per cent) showed negative cultures at the second sitting after one treatment, 31 (91 per cent) after two treatments, and 33 (97 per cent) after the third treatment. Only in 1 case of the 34 cases of *Series G*, we could not obtain negative cultures using the nebacetin solution. Of course we tested the organisms and although the organisms showed some sensitivity to nebacetin the inhibitory zone was rather small—the diameter being less than 20 mm.—whereas both penicillin and oxytetracycline, i.e., terramycin, produced an inhibitory zone with a diameter of more than 30 mm. The treatment of this case was without any complication brought to an end with penicillin.

It is too early to form a definite estimate of the suitability of nebacetin as an antibacterial remedy in the treatment of infected root canals. Further clinical material must be collected and tested bacteriologically, and the clinical results of the treatment with nebacetin must be compared with the results obtained by using other remedies and other principles of treatment. The results seem, however, to be rather promising, but there are still questions open regarding the use of antibiotics in root-canal treatment as a whole that want answering, and that I should like to discuss on this occasion.

1. In the first place we should remember, that in the usual antibacterial treatment of infected root canals we use chemical disinfectants that destroy the bacteria. The antibiotics interfere with the metabolism of the bacteria and may thus in some cases indirectly kill them, but in most cases they only inhibit their growth and their propagation. When the antibiotics are used parenterally or inwardly the bacteriostatic effect will aid the organism in its fight against the micro-organisms in rendering the bacteria more easily destroyable by the leucocytes. In the root canals a bacteriostatic effect is of no real value, because the avoiding reaction of the organism cannot come into action. If we want to use antibiotics in the treatment of infected root canals we must use very active antibiotics that are bacteriocidal, such as penicillin, bacitracin, streptomycin, or neomycin. The newer antibiotics, as tetracycline and its derivates, that are very effective bacteriostatics but not bacteriocidals, *should not be used in treating infected root canals—at least they should not be used alone.*

2. Secondly it should be remembered that the antibiotics are all selective in their action. This general law even applies to the modern antibiotics with broad spectra of activity. From this it can be inferred that in no case should a single antibiotic be used alone, but always in combination with another antibiotic, supplementing its spectrum of activity as, for example, penicillin and streptomycin or bacitracin and neomycin. Even in using such a combination one cannot be 100 per cent sure of the bacteriocidal effect of the compound, and here is another crucial point in the use of antibiotics in root-canal therapy: One should always run bacteriological tests and even sensitivity tests controlling the possible survival of resistant bacteria, and this procedure will render the treatment too complicated for general use in the dental surgery. Not until reliable bacteriological re-examinations of the reports of the claimed sterilization of infected root canals, obtained by polyantibiotic treatment, have been published can current bacteriological controls be discontinued.

3. In the third place the occurence of yeasts, and especially of *Candida albicans*, should be

remembered. Grossman has found *C. albicans* in approximately 17 per cent of 1000 untreated cases examined. Seltzer and Bender found it in 20 per cent of cases of infected root canals treated with antibiotics, and in Copenhagen we have found the fungus in root canals treated with antibiotics in a still greater percentage, even up to 40 per cent. Up till now none of the fungicidal antibiotics known has proved suitable for use in root canal work. Most of them are too toxic or their tissue-tolerance is too low. Although not a single case of generalized infection with this obstinate fungus due to antibiotic treatment of infected root canals to my knowledge has been reported, the risk of such an infection should be considered. Several chemicals have been recommended for destroying the fungus, foremost sodium caprylate, known from dermatology for its fungicidal effect, and recommended by Grossman and by Seltzer and Bender in their polyantibiotic compounds. In Copenhagen we have tried many various fungicides with very varying results. At present we should therefore recommend in all cases where antibiotics have been used in root-canal therapy, to flush the canal just before placing the root-canal filling with a 0·1 per cent solution of phenyl-mercuri-acetate.

4. The fourth objection to the use of antibiotics in root-canal therapy is that we cannot be sure of the effect of the antibiotic on bacteria in the apical ramifications or in the dentinal tubes. Shuttleworth has shown in laboratory experiments that penicillin from the pupal cavity can penetrate the dentine and even the cementum. Bennett and Miles have recently in their experiments shown that penicillin placed in the pulp cavities of freshly extracted teeth cannot be detected on the root surface if covered with cementum. If the cementum is missing, penicillin does penetrate the whole thickness of the dentine.

Although these laboratory experiments demonstrate the possibility of the diffusion of penicillin into the dentine, we still do not know whether the penicillin is capable of destroying the bacteria present within the dentine, and consequently we shall have to consider the possibility of re-infection of the root canal from the dentine.

5. This leads on to the fifth objection, and maybe a more important one, against antibiotic root-canal therapy—namely, that our present bacteriological control methods are unsatisfactory or at least insufficient. In most cases we only take swabs with absorbent points from the inside of the canal or use a paper-point that has been placed in the root canal to soak up fluid as inoculum. Using this primitive technique *we may or we may not* get hold of living bacteria from the surface of the root canal. In other words only the positive cultures are of real value. But there are other objections against the usual bacteriological technique used. Generally only aerobic cultivation is used. Grossman states in his book *Root Canal Therapy*: "Culturing samples from root canals under anaerobic conditions is unnecessary". This cannot be true. In Copenhagen we have in quite a number of cases cultivated obligate anaerobes from infected root canals, so that we now as a routine run both aerobic and anaerobic cultures simultanously, using a semisolid sodium glycollate medium to which is added methyl blue as an indicator of the redox potential. The most valid objection against the bacteriological test is, however, the constant risk of carrying small amounts of the antibiotic used in the treatment along with the inoculum into the medium, thereby jeopardizing the control. This possibility can be provided for where penicillin and streptomycin have been used in adding either penicillinase or hydroxylamine, but for no other antibiotic an appropriate inhibitory principle is available. Much work has been done to overcome this difficulty, but up till now no absolutely reliable technique has been published. Grossman has in his end-point studies recommended the dilution of samples from all negative cultures in the proportion of 1–1000, thereby reducing the possible bacteriostatic influence of the antibiotic accidentally contaminating the sample. In Copenhagen we take as a routine from all negative cultures after nebacetin treatment, samples with a calibrated platinum eyelet containing $\frac{1}{500}$ c.c. and transfer this inoculum

to 10 c.c. of ordinary glucose-peptone broth. This means a dilution of 1–5000. The inoculated test-tubes are incubated at 37° C. for five days, and up till now we have in no case found any turbidity indicating the presence of cultivable living micro-organisms.

Bender and Seltzer have in 1954 tried to analyse the probability of error of the negative cultures with the use of antibiotics in endodontic treatment. They estimated the error with the usual technique of inoculation to be round 13 per cent.

This criticism of the bacteriological technique that has been used asserting the favourable results of antibiotic treatment of infected root canals, once more stresses the necessity of both laboratory facilities and bacteriological competence that cannot be available in the general dental surgery.

6. Still more objections may be raised against the use of antibiotics in root-canal therapy. When the penicillin was first introduced into human therapy it was thought that a miraculous remedy had been discovered without any side-effects. Time has shown that penicillin is still the most harmless of all antibiotics, but even penicillin has side-effects, just to mention the sensitization of the patients towards penicillin. In Denmark quite recently a few fatal cases of anaphylactic shock have been reported from single intramuscular penicillin injections. Taking into account that the topical application of an antibiotic may jeopardize its general use later in life, when maybe its use is urgently needed on vital indications, our enthusiasm in using every new antibiotic without the slightest regard to indication, as has far too often been the case, should be damped. It is a well-known fact that the newer antibiotics with broad spectra of activity have a tendency to promote development of resistance to the antibiotic used. To my knowledge no case of development of resistant bacterial strains that could be traced back to the use of an antibiotic in root-canal therapy has been reported, but there is a potential risk that such cases might be found. Cases have, however, been reported of manifestations of an allergic nature, caused by the use of penicillin in root-canal therapy. Bender and Seltzer have reported 2 cases of idiosyncratic reactions. In one of them the patient was taken into hospital in an asphyxial state due to œdema of the glottis. Such cases are extremely rare but they should anyhow be considered and the potential risk of fatal complications should not be belittled. Ostrander has drawn attention to the fact that sensitization towards penicillin is more common than generally assumed and *New and Non-official Remedies* 1951 states: "Topical application of penicillin is most likely to produce sensitization, and it should not be used in this way".

It seems accordingly completely justifiable to warn against the indiscriminate topical use especially of such antibiotics as are liable to induce development of resistance and possess high allergic indices. Consequently we should in root-canal therapy choose such antibiotics as cannot be used generally or that are only seldom used generally and on special indications. We have such topical antibiotics, e.g., tyrothricin, that, however, for some reasons does not seem to be effective enough for endodontic use, and now nebacetin that according to our experience in Copenhagen should be considered as a very promising topical antibiotic combination.

I have tried to collect some items concerning the use of antibiotics in root-canal therapy as a special form of the topical use of antibiotics. I will just before closing my address formulate another question:—

Is there such a great need for the topical use of the antibiotics in root-canal therapy that we must put up with all the inconveniences already mentioned and even the uncertainties regarding their antibacterial effect?

Ostrander in the U.S.A. has clearly stated in 1953 that he does not allow the use of antibiotics in root-canal therapy in Ann Arbor because results are neither better nor obtained in less time than with the usual chemical remedies and because of the uncertainty of the bacteriological methods of control. Castagnola and Späti in Switzerland state that hitherto the use of combinations of antibiotics in root-canal therapy have not shown advantages over the use of the normal chemical disinfectants.

Harnisch and Lammers in Germany state that the use of antibiotics in root-canal therapy should be rejected.

In my opinion these statements are far too pessimistic, although I must admit that the use of antibiotics in root-canal therapy is still in the experimental stage.

I should like to end my lecture citing Grossman who in 1952 stated: "Antibiotics are extremely useful agents for the treatment of infected root canals, but they are no panacea. They will not make up for poor débridement or mechanical cleansing and enlarging of the root canal", and I should only like to add that new remedies, whether antibiotics or others, should always be used intelligently and under the control of scientific testing methods.

PROBLEMS OF CHILDREN'S DENTISTRY

By **P. M. C. JAMES**, L.D.S. R.C.S., D.P.D.
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I. THE EDUCATION OF THE PARENT

CHILDREN'S dentistry is a creative science and should be directed particularly at the prevention of dental disease so that operative procedures can be reduced to a minimum. Education of the parent is an essential factor in preventive dentistry, and for this reason mothers should be encouraged to bring their children to the dental surgery at an early age not only to accustom the child to the environment but also to discuss with them the problems of dental caries and methods of controlling it.

The dental surgeon sometimes has his first opportunity for parental education in dental matters if his advice is sought in connexion with teething troubles. Many ailments are attributed to teething, mostly without justification, but there seems no doubt that it may be accompanied by soreness of the gums, sleeplessness, and general irritability. There is a popular belief that honey and borax applied to the site of irritation will alleviate the symptoms, but, whether or not this is true, there is no doubt that the introduction of honey in a concentrated form for long periods of time will have a disastrous effect on any teeth that are present. Mothers should be told not to give the child a dummy dipped in honey, rose-hip syrup, condensed milk, or any other sweet sticky substance as the habit may be difficult to break. If an application is thought necessary for the gums when teething a mixture of equal parts of Liquor arsenicalis, Tinc. ipec. and glycerin painted on before meals will help (Ursula James, 1956) and early weaning on to mixed feeding is desirable. Teething powders should not be recommended.

When the deciduous dentition is present the child should have a dental examination every six months at least and the general principles of caries control explained to the mother as early as possible. It is helpful if a printed or Roneod sheet can be supplied for home reference. The salient points might be as follows:—

1. Nothing sweet or sticky should be given between meals, and this applies to drinks as well as food. Biscuits or sweets must not be taken with the school milk at mid-morning—instead offer fresh fruit, nuts, raisins, or potato crisps.

2. If sweets must be given see that they are all eaten at once, perhaps after lunch, and that the teeth are cleaned afterwards. A simple explanation of the principles of oral sugar clearance will allow parents to appreciate the importance of avoiding high sugar concentrations in the mouth for long periods. They readily grasp the idea that a lot all at once is preferable to a little spread over a long time. It should be stressed that it is concentration and frequency rather than total quantity of fermentable carbohydrates that is so important (Gustafsson, Quensel, Lanke, Lundqvist, Grahnen, Bonow, and Krasse, 1952).

3. The child must not have supper in bed. The last meal of the day should be given at least half-an-hour beforehand, and this meal should end with a detergent food; sliced apple with the skin left on is popular and efficacious. The physiological movements of the lips, cheeks, and tongue with the normal flow of saliva will help then to ensure that no gross debris lies about the teeth during the sleeping hours. The child who has supper in bed is often asleep soon after the final mouthfuls, and the lack of salivation and cleansing movements during sleep make the dentition particularly susceptible to carious attack. The teeth should be brushed carefully under parental supervision and nothing further given to eat or drink, except water. It should be emphasized that this particularly includes medicines, tonics, and vitamin syrups.

4. Many medicines are syrupy and acid. Certain iron tonics are known to damage the teeth (James and Parfitt, 1953; Torell, 1955) and the vitamin-C syrups, such as rose-hip or black-currant syrup, are high in glucose content, very acid, and very sticky. All these should be well diluted and given with meals, not after or between.

5. Good oral hygiene must be promoted as this is socially desirable, beneficial to gingival structures, and prevents buccal, lingual, and, labial caries.

6. Fats form a temporary film of grease over the tooth surface and it has been shown that cariogenic foods are less harmful if mixed with greasy substances (Rosebury and Karshan, 1939). A fried dish at breakfast may be beneficial both in this respect and in that it might replace the usual sugar-frosted cereal flakes with added sugar!

If these simple rules are conscientiously applied, dental caries would be reduced to a minimal level. It is, of course, possible to eliminate caries almost entirely by strict dieting, but such a régime would not be tolerated by the average person in this country.

It is a sad reflection that the best dentitions here are mostly to be found among underprivileged children in remand homes and orphanages.

The usual reply of parents to advice about the necessity for reducing the consumption of fermentable carbohydrates is to cite neighbours' children who consume astronomical numbers of sweets and biscuits without ill-effects on their teeth. It must then be explained that while sugar in certain forms may be regarded as the exciting factor in the production of dental caries, various predisposing factors of tooth morphology, tooth structure, oral hygiene, salivary bacterial and biochemical content, etc., will determine the level at which the exciting factors overcome the individual resistance. Parents often grasp simple analogy and usually appreciate that if a match is applied to a bonfire the resulting conflagration or lack of it will depend on the state of the bonfire and various other conditions of wind and weather at the time. If the bonfire does not catch fire it would be fallacious to deduce that matches do not set fire to bonfires!

Parents often ask what can be given to ensure strong teeth in their children. They should be advised that an adequate intake of vitamins A and D, if necessary in the form of cod-liver oil, is desirable, but this does not minimize the necessity for care in eating habits later. The fluoridation of drinking water will, it is hoped, ensure much more caries-resistant teeth in future generations, and the opportunity of acquainting the mother in the advantages of this public health measure should not be lost. With regard to queries about "the best toothpaste", it should be stated that no toothpaste, as yet, contains a proven specific against caries (Nikiforuk and Macdonald, 1955), but that should not prevent a particular brand from being recommended. If the "doesn't matter" line is adopted it is liable to be interpreted incorrectly.

In certain cases of gross caries it is desirable to investigate the habits of the patient rather fully. At the first visit a five-minute sample of saliva may be collected and a salivary lactobacillus count carried out in accordance with a standard technique (James and Parfitt, 1954). The lactobacillus count will almost certainly be very high; whereas the average patient will have a count of tens of thousands per ml. of

saliva, the rampant caries patient shows counts of hundreds of thousands, or even millions, per ml. The teeth are charted in detail for caries and decalcification after the collection of saliva and the patient dismissed for one week, having been asked to record on paper every detail of his diet over the intervening period, taking care to ensure that it is understood that diet includes everything eaten or drunk, whatever its nature. No advice should be given to the patient at this visit and no leading questions put that will give any clues about the sort of diet that concerns the teeth or the written record will consciously or unconsciously be influenced.

At the second visit another saliva sample is collected for comparison with the first. It has been found that the majority of these second counts are in the same order as the previous one and the mean of the two counts is taken as representative of that patient. The diet sheet is scrutinized and discussed with the patient or parent and any errors pointed out. A dietary régime in accordance with the principles of caries control is suggested and oral hygiene instruction given. After two weeks the saliva is again tested. If the patient has been co-operating the count will be substantially reduced (Kitchen and Permar, 1955). Further tests at intervals will record progress and give the patient encouragement, as the results can be seen and demonstrated. It should be explained that as there is a considerable time-lag between the cause of dental caries and the clinical manifestation of it, some time must elapse before clinical improvement is noticed (Parfitt, 1956).

The freeing of sugar from rationing and the flooding of the market with every kind of sweet sticky foodstuff has had a serious effect on the teeth and the improvement observed after the war years has not been maintained. The present trend is one of gradual deterioration, and the dental services in this country, already overstrained, will shortly become totally inadequate. There is no doubt that eventually some method will be found for eliminating dental caries, but at the moment the dental health education of patients, *privatim* or *seriatim*, together with the artificial fluoridation of water, offers the only hope of controlling the ravages of this unpleasant disease.

II. APPROACH TO THE CHILD PATIENT

It is a great advantage if children can be examined continuously from an early age, and 2 years old is a good time to start. The average child at this age has little or no operative treatment necessary and will, therefore, become accustomed to the dental surroundings without loss of confidence occasioned by unpleasant experiences.

At the first visit it is advisable to allow the mother to bring the child into the surgery. It has been found better on this occasion to remove the white coat as very often a child of this age associates white coats with unexpected punctures with a needle. If the dentist remains seated he avoids towering over the child, who may be examined, using a mouth mirror, standing by the chair. No attempt should be made to put the child in the dental chair unless he is willing or even eager for the "ride". The whole visit may take only two or three minutes, but it starts the essential snowball of confidence and friendship between operator and child.

When dealing with children, the dentist should cultivate an air of absolute confidence, as the child immediately senses uncertainty or indecision and may respond unfavourably. Fiddling with instruments should be avoided and everything necessary must be done with great precision and absolute certainty. Appointments should be short as small children quickly tire. Too much playing should also be avoided otherwise children get the idea that they have come to play and resent the intrusion of operative dentistry. A small present of a cotton-wool roll or an empty bur box delights a child out of all proportion to the value.

Even small children should be told in very simple terms what you are doing and the casual request that they hold an instrument for you "to help" gives them a feeling of co-operation and if done at the psychological moment may turn the scale decisively towards that end. If difficulty is experienced while

using the handpiece the child should be told that you will stop at once if he so desires—raising the hand is a satisfactory code although rather liable to be abused. The child should never be misled or deceived in any way, but no direct reference should be made to "pain" or "hurting". Fortunately the deciduous teeth are relatively insensitive and cavity preparation is usually painless, although the child may object to the noise or the vibration.

Nervous Children.—Nervous children are different from naughty children, although a child may be both. Often there is a history of an unpleasant experience, usually extractions or injections. It is necessary to regain their confidence, so some painless operation should be done at the first visit, such as polishing the teeth with a rubber cup. If a child has had extractions and resists cavity preparations on other teeth it may be explained that filling teeth will preclude the necessity for further extraction, but the alternative of extraction should not be held as too much of a bogey lest it should become necessary later in spite of the child's co-operation. Any extractions necessary should, if possible, be delayed until *after* the conservative treatment is completed; if initial extractions are indicated because of pain, care must be taken to extract *all* the doubtful and unsavable teeth to avoid a second general anæsthetic where possible. A very common shortcoming in treatment planning for children is to extract a painful tooth at the first visit and find later that several others are unsavable as well.

Naughty Children.—There are fortunately not many of these, but samples are found at all age levels. The parents are frequently to blame—they indulge and tolerate tantrums and disobedience at home but expect the dentist to be endowed with miraculous powers of persuasion. A firm line is usually necessary with these children and the parent should be excluded from the surgery. The attention of the child must be absolutely focused on the dentist, who should tolerate no interference from anyone else, however well meaning. The dental nurse should remain apart from the operation as a child will turn instinctively for sympathy towards a third party and the direct patient-operator contact may be broken at a critical moment by the nurse, for example, taking the patient's hand. A calm matter-of-fact air should be adopted towards rage and frustrated screaming. The child watches for a reaction and if no reaction is obtained the seed of doubt is sown as to the success of the method. Intractable children may be premedicated with seconal according to their weight prior to their visit.

The parents' attitude towards their child's dental appointment is important. If they have shown agitation beforehand, promising them toys "if they are good" or threatening them "if they don't behave" or reassuring them "he won't hurt you", then the child will almost certainly arrive at the surgery in a state of fearful anticipation. Parents should be told to adopt a matter-of-fact attitude, implying that dental treatment is a necessary routine, neither pleasant nor unpleasant.

Local Anæsthetics.—These, in the experience of the author, are hardly ever required for conservation of the deciduous teeth, but often necessary for cavity preparation of young permanent teeth. Children are quick to appreciate the advantage of them and very difficult children often change their entire outlook following the successful use of local anæsthetics. It is important to make the decision for injection early in the visit, not using the local as a last resort after a painful attempt to prepare a cavity without.

In general children are extremely good patients and once their friendship and co-operation is gained they will tolerate far more than the average adult.

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BONE*

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BONE is a connective tissue and, being calcified, is specially adapted to provide the vertebrate body with mechanical support. The vertebrates depend upon the rigidity of bone for their powers of locomotion and the more delicate organs such as the central nervous system are found to be encased within a protective sheath of bone. Furthermore, all those creatures who depend for their existence upon specialized teeth, such as the rodents, carnivora, insectivora, or herbivora, become incompetent and die if they cannot maintain the bone of their alveolar processes. It is my intention in this paper to deal with the composition, structure, and development of bone, and to discuss the question of bone resorption.

THE COMPOSITION OF BONE

Bone in any of its forms consists of organic and inorganic components. The organic components are the cells, the fibres, and the amorphous cementing substance. The non-cellular elements, i.e., the fibres and the cementing substance, together comprise the bone matrix. Sometimes, between adjacent structural units of bone, narrow bands of matrix are seen which are devoid of fibres and these are referred to as "cement-lines". The inorganic component consists of mineral salts. Although several varieties of bone are to be found, the differences are entirely due to a variation in the distribution and proportions of these components.

The Bone Cells or Osteocytes.—These are bone-forming cells which become incorporated within the bone mass as it forms. In some primitive types of bone they appear to be little more than incidental inclusions (Crawford, 1940), but in mammalian bone they probably play a part in the maintenance of bone as a vital tissue.

The Fibres.—Most of the fibres which become incorporated in the bone matrix are collagen. Electron microscope studies show that collagen fibres in bone have the same general characteristic as collagen fibres in connective tissues elsewhere. Reticulin fibres in small quantities are also found in the bone matrix (McLean and Urist, 1955).

The Amorphous Cementing Substance.—In bone this is the counterpart of the ground-substance which fills in spaces in the soft connective tissues. The cement substance contains mucopolysaccharides, including hyaluronic acid and chondroitin sulphate, and these materials may enter into a loose combination with collagen. The mucopolysaccharides also undergo polymerization, as a result of which they exhibit variations in staining reaction. For example, when highly polymerized they may stain metachromatically with certain stains, while in the less polymerized state they give a more intense reaction with the periodic acid Schiff method because there are then more aldehyde groupings available for linkage to the colourless leucofuchsin. Quantitative analysis shows that the amount of mucopolysaccharide present is in the order of less than 1 per cent. Rogers (1951) gave the figure of 0·4 per cent for cortical ox-bone.

The Inorganic Salts.—These are present as submicroscopic crystals with a structure and composition which are approximated by the formula of the hydroxy form of the series of double calcium salts known as the apatites. McLean and Urist (1955) give as the formula for hydroxy-apatite—

$$3Ca_3(PO_4)_2.Ca(OH)_2.$$

Also present are carbon dioxide, citrate, water, and traces of sodium, magnesium, potassium, chloride, and fluoride.

BONE TYPES

The histological classification of bone as a tissue is based upon the character and pattern of the incorporated fibres and cells. Both

* Being a paper delivered to the British Society of Periodontology at the Eastman Dental Clinic, on Feb. 6, 1956.

phylogenetically and ontogenetically, irregularity of bone pattern is a primitive feature while the geometric perfection in the pattern of mammalian bone represents a high level of adaptation to function. The three types of bone which can be distinguished on this structural basis are "woven bone", "lamellar bone", and "bundle bone".

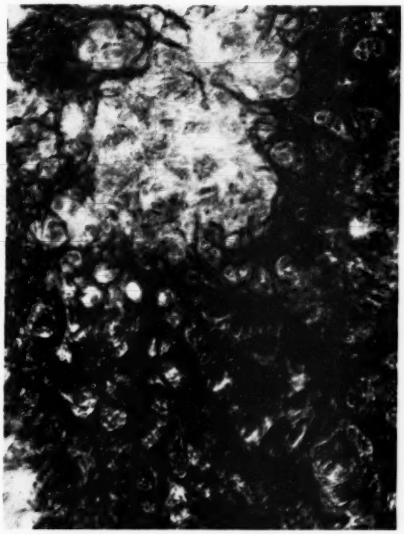

Fig. 1.—Fibre pattern in woven bone. Section of maxilla of 10-months infant. Silver impregnation. (× 264.)

Fig. 2.—Showing difference in texture and pattern between fine-fibred woven bone (f.f.) and coarse-fibred woven bone (c.f.). Gram-Weigert. (× 264.)

Woven Bone.—According to Baker (1950), von Ebner, in 1875, used the German word "geflechtartig" to describe this tissue. The exact meaning of this word apparently refers to a particular type of basketwork and there is no strict English translation. Baker credits Turnbull with the introduction of the word "woven" as its nearest equivalent.

Woven bone can be further classified according to whether the fibres are present in coarse bundles or as fine fibrils.

a. Coarse-fibred Woven Bone.—This is found in the fœtus and during the first year of life. Thereafter it is found in childhood in the periosteal "ferrule" of bone which extends from the periosteum of the shaft of the long bones and surrounds the epiphysial plate. It also occurs under pathological conditions, especially when bone is formed rapidly. It is the callus which provides primary union following a fracture; it is the bone which first fills a healing tooth socket and it may appear in tumours.

The fibres run in intertwining bundles within the matrix and in sections they are seen coursing and weaving in all directions. Fearnhead and Linder (1956) have recently described a silver impregnation technique for nerve staining, which slightly modified demonstrates the fibrillar pattern in bone very clearly (*Fig.* 1). Numerous cells become incorporated in the matrix and occupy cell-spaces scattered haphazardly and varying greatly in size and shape. Running from the cell spaces are a few canaliculi which exhibit no uniformity in their number, diameter, length, or direction. Coarse-fibred woven bone stains more deeply with hæmatoxylin and gives a more intense periodic acid Schiff reaction than do other types.

b. Fine-fibred Woven Bone.—In this type the fibres do not run in bundles, but are more finely divided and more evenly distributed

(*Fig.* 2). The cell-spaces begin to show a greater regularity of size and spacing. The general pattern may closely resemble that of lamellar bone so that it is also sometimes referred to as intermediate bone.

Lamellar Bone.—In lamellar bone systems are found consisting of layer upon layer of bone, the fibres in which are all of the fine variety and are orientated in the same direction in any one layer or lamella. The fibre direction changes from one lamella to the next, so that there is a change of direction between the fibre systems of successive lamellæ of between 45° and 90°. The end-result is frequently likened to plywood and the advantages are obvious when considering the ultimate strength of the structure (*Fig.* 3). Examination of sections of lamellar bone under polarized light provides a dramatic picture of alternating light and dark bands.

There is no precise knowledge as to the mechanism which governs this orientation of the fibrils between successive lamellæ. It has been demonstrated, however, that collagen fibres can undergo solution and reprecipitation with variations in *p*H. Weinmann (1955) has suggested that such a mechanism may be responsible, and may be a function of the osteoblasts.

The osteocytes lie in spaces which are very regular in size and shape, being flattened between the lamellæ (*Fig.* 4). From each cell-space canaliculi run from each side to intercommunicate with adjacent cells or with the surface. The canaliculi represent channels left in the bone matrix by the intercellular bridges which connect one osteoblast to another. When completely embedded, the osteocyte is thought to retract its cytoplasmic processes from the canaliculi into the cell-space or lacuna. The canaliculi can then provide pathways for the nutrition of bone. Ham (1952) has pointed out that, whereas exchange of metabolites can take place in the non-calcified connective tissues by a process of diffusion through the tissue fluid and ground substance, no diffusion can take place in the analogous cement substance in bone matrix once it has become calcified. In lamellar bone the osteocytes by their metabolic activities promote diffusion of

Fig. 3.—Lamellar bone with fibres in alternate lamellæ cut transversely and longitudinally. Two areas are seen separated by a fibre-free cement line (c.l.). Silver impregnation. (× 800.)

Fig. 4.—Lamellar bone showing cell spaces both in plan and elevation, and inter-communicating canaliculi. Schmorls thionin. (× 264.)

metabolites through the canaliculi and maintain a certain amount of metabolic exchange. At the best, this mechanism is not very efficient, and there is a limit to the distance an osteocyte can be separated from uncalcified connective tissue and still remain alive. Consequently in primitive vertebrates, the cell spaces in the deeper parts of large bone masses are often

Fig. 5.—Haversian system. Silver impregnation. (× 264.)

found to contain no living cells. In the mammals a system has developed whereby bone cells can remain vital even within the thick masses of dense bone which provide for skeletal strength. Dense bone is found to be composed of numerous units each consisting of lamellar bone disposed circumferentially around a central vascular bundle, the whole arrangement constituting the Haversian system (*Fig.* 5), in which no osteocyte is found more than about 0·1 mm. from a blood-vessel. The compact bone forming the cortex of the long bones or the mandible is composed entirely of lamellar bone arranged in Haversian systems.

Bundle Bone.—Where ligamentous insertions and tendons enter bone, numerous bundles of collagen fibres become incorporated, and these are referred to as Sharpey fibres. Stein and Weinmann (1925) found Sharpey fibres in the bone lining the dental alveolus and introduced the alternative term "bundle bone". This type of bone exhibits an apparent lamellation produced by incremental lines parallel to the surface but with no relation to changes in fibril direction as in lamellar bone. Bundle bone stains more deeply than lamellar

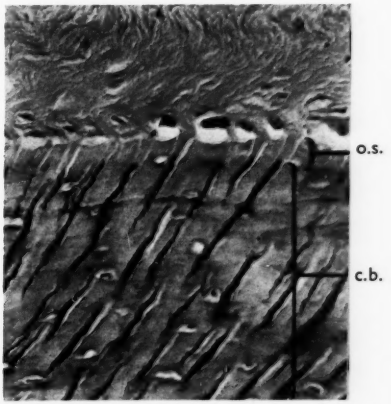

Fig. 6.—Sharpey fibres entering alveolar bone. There is a sharp transition from pale to deep purple as the fibres pass from the uncalcified osteoid seam (o.s.) into the fully calcified bone (c.b.). Gram-Weigert. (× 264.)

bone with hæmatoxylin and with periodic acid Schiff.

The periodontologist has a special interest in bundle bone because it forms the immediate bone of attachment of the teeth by providing anchorage for the principal fibres of the periodontal membrane. A subject of greater detail but of equal importance is the way in which the Sharpey fibres are firmly embedded within the bone. The alternatives to be considered are either a mechanical form of attachment or an adhesive bonding which may be a function of the cement substance. In sections the fibres do not fan out nor have they any side branches which would provide a mechanical anchorage. Turning to a consideration of the second alternative, no appreciable change in staining reaction can be seen in the Sharpey fibres as they pass into the bone when stained with the commonly used methods of hæmatoxylin and

eosin, Van Giesen, and silver impregnation. When sections of bundle bone are stained with Gram-Weigert fibrin stain, however, a dramatic change can be seen as the fibres reach the calcified portion of the bone (*Fig.* 6). Similarly, well-marked changes can be seen in sections stained with Heidenhein's azan. In this case the fibres lose their distinctly fibrillar deep-blue appearance and take on a non-fibrillar purple character as they pass through the non-calcified osteoid border of the bone. At a deeper level in the fully calcified parts they are a bright red (*Fig.* 7). An interpretation of these findings cannot be made at present, except to say that fixation of Sharpey's fibres in bone appears to be associated with a qualitative change in the cement substance, and that this change may be related in some way to calcification.

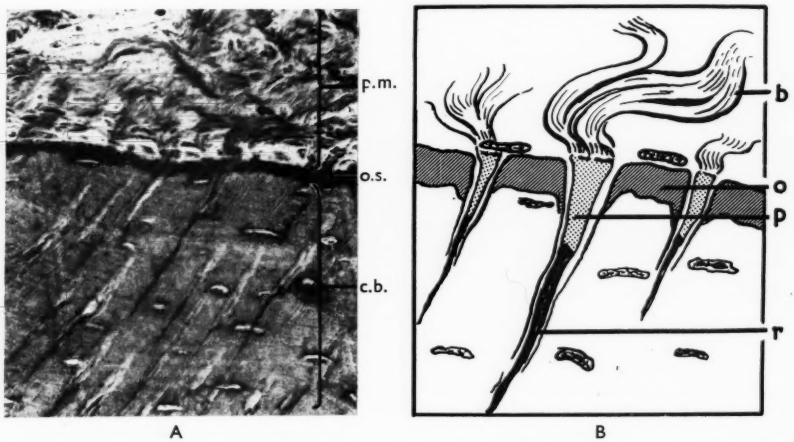

Fig. 7.—A, Sharpey fibres entering alveolar bone. The deep blue fibrillar appearance in the periodontal membrane (p.m.) changes to a more hyaline purple in the osteoid seam (o.s.). Deeper in the calcified bone (c.b.) the fibres stain deep red. Heidenhein's azan. (× 264.) B, Diagrammatic representation of colour changes shown in A: b, Blue fibres in periodontal membrane; p, Purple zone in osteoid seam; r, Red fibre in calcified bone; o, Osteoid.

THE DEVELOPMENT OF BONE

There are two ways in which bone may develop, either by intramembranous ossification or endochondral ossification.

Intramembranous Ossification.—This method is responsible for the growth of bone in such sites as the flat bones of the skull and the mandible. The first evidence of ossification occurring in these situations is a bonding together of the connective-tissue fibres with cement substance which together form a coarse-fibred bone matrix. Cells in the vicinity become differentiated to form functional osteoblasts and calcium salts are soon deposited, thus producing irregular trabeculæ of woven bone in which numerous osteoblasts become incorporated as osteocytes. The qualitative changes taking place can be demonstrated histologically by alterations in the staining characteristics. The extreme borders of the developing trabeculæ of bone are seen to be composed of an apparently non-calcified pre-osseous tissue, and these peripheral parts are known as osteoid seams. The process is well illustrated in the cranial bones of the fœtus (*Fig.* 8).

Being a rigid tissue, the only way in which bone can increase in quantity is by surface apposition. As the osteoid seam becomes calcified to form bone, another successive layer of osteoid is formed on the surface which in turn becomes calcified.

Coarse-fibred woven bone is the only type which can be formed in this way, i.e., by

direct metaplasia of the existing tissue elements. Once a framework of woven bone has been established in this way, however, any of the other types can be deposited upon its surface (*Fig.* 9). Resorption of the original trabeculæ takes place in due course, with replacement of the woven bone, until ultimately the structure consists in the adult wholly of lamellar bone.

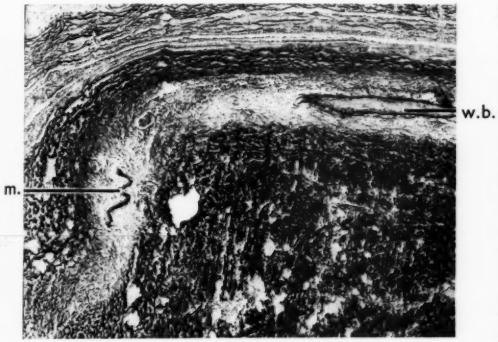

Fig. 8.—Intramembranous ossification in margin of parietal bone in 6-months' fœtus showing earliest connective-tissue changes (m.) and established woven bone (w.b.). Heidenhein's azan. (× 33.)

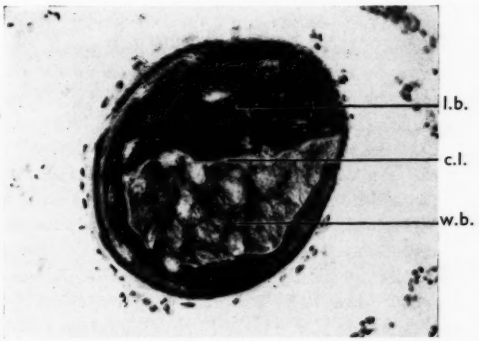

Fig. 9.—Showing lamellar bone (l.b.) deposited upon woven bone (w.b.) with a fibre-free cement line (c.l.) between the two. Maxilla of 10-months' infant. Silver impregnation. (×220.)

Endochondral Ossification.—In this case a model of the bone is preformed in cartilage, and this process is seen characteristically in any of the long bones. The secondary cartilage in the mandibular condyle is also a site of endochondral ossification.

The process is best studied by examination of the epiphysial plate and metaphysial region of a growing long bone (*Fig.* 10). Towards the metaphysis the cartilage cells increase greatly in size, and come to be arranged in columns, while the amount of intercellular material is proportionately decreased and then becomes calcified. Calcification may prevent the diffusion through the mucopolysaccharides of the cartilage of the materials required for the nutrition of the cartilage cells, which subsequently degenerate and die. They are removed by tissue macrophages and their place taken by capillary loops and connective-tissue cells which have osteoblastic potentialities. Bone is then deposited upon the scaffolding of calcified cartilage matrix, and remnants of this tissue can be identified in bone trabeculæ extending down into the shaft of the bone. Ultimately all these remnants disappear as a result of the remodelling which takes place as growth proceeds, and the relatively primitive bone first deposited is completely replaced by lamellar bone.

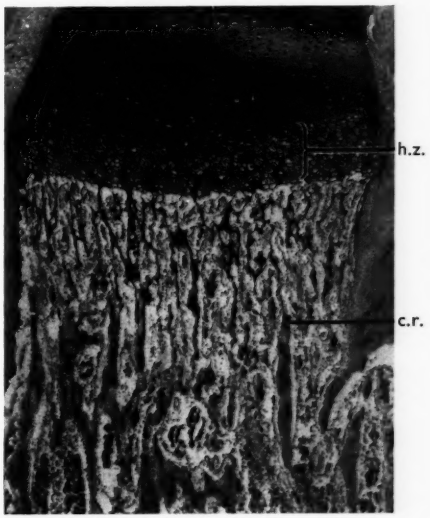

Fig. 10.—Endochondral ossification. Tibia from 20-weeks' fœtus. Showing columns of enlarged cartilage cells in the "hypertrophic zone" (h.z.) and remnants of calcified cartilage (c.r.) within the bone trabeculæ of the shaft.

BONE RESORPTION

Paradoxically, bone removal is an important feature of bone growth. This is obviously true in the case of bones as organs, but it is equally true when considering bone as a tissue. It has already been mentioned that bone can only grow by apposition because of its rigid nature, and it has been pointed out that the problems associated with the maintenance of bone as a live tissue have resulted in the evolution of the Haversian system. Removal of the first formed bone is therefore an essential factor in the growth of bone in order to provide for the remodelling of bone in the Haversian pattern.

The method by which resorption of bone occurs has been a controversial subject for many years. Essentially there are two points of view. The first is that the bone salts can be withdrawn by a humoral mechanism and returned to the tissue fluids from which they are assumed to have come, leaving behind a decalcified bone matrix. This theory has been called "halisteresis" or "osteolysis", of which the great protagonists were Leriche and Policard (1926).

The second point of view, which is more generally accepted, is known as "osteoclastic resorption" and comparatively little has been added since Kölliker first described the giant-cell osteoclast in 1873. It is generally conceded that osteoclasts remove bone piecemeal without producing in the process any demonstrable qualitative changes. No intermediate stages can be seen between fully calcified bone and its complete removal, but no evidence has been produced to show how osteoclasts function. Circumstantial evidence shows that whenever bone is undergoing resorption, osteoclasts are seen lying in little bays or Howship's lacunæ which appear to have been nibbled away in the bone surface. But the mere presence of osteoclasts, even with such constancy, does not mean that they are directly responsible for resorption. Calcium salts have never been demonstrated within osteoclasts, and Ham (1952) has suggested that the mechanism is in a sense a negative one. He postulates that the calcium salts are only retained in the bone by the continuous formation of alkaline phosphatase by osteoblasts ranged along the bone surfaces. When the osteoblasts are replaced by a cell such as the osteoclast, the mineral salts diffuse out of the mucopolysaccharides of the bone matrix, leaving the fibrils which can be demonstrated as a brush border either on the bone surface adhering to the osteoclast, or bridging the space between the two. Kroon (1954), on the other hand, in a careful histological and histochemical study of the brush border of the osteoclast, is of the opinion that it consists of fine cytoplasmic processes of the osteoclast which penetrate the bone, and represents a functional activity of the osteoclast.

There are two further problems relating to the osteoclasts which should be mentioned briefly. Firstly, where do they come from? Some authorities suggest that they are osteoblasts in a different phase of activity, but others, for instance Ham (1952), do not accept this view. It is still undecided whether they acquire their multinucleate form by a repeated nuclear division without corresponding division of the cytoplasm, or whether they are formed by the fusion of cells, probably macrophages. The latter view is supported by the work of Heller, McLean, and Bloom (1950), who found that, following the administration of parathormone to several species of small laboratory mammals, osteoclasts appeared in such great numbers within a few hours that the possibility of repeated nuclear division could be excluded.

The other problem concerns the way in which calcium salts, with or without the organic matrix, can be removed, within the range of *p*H which can be tolerated by the tissues. No answer could even be suggested until the advent of a group of substances known as the chelating agents. These substances, even in a strongly alkaline solution, are able to form linkages with metallic ions such as calcium, to make complexes which ionize very poorly and can take up calcium. It is now possible to postulate a new hypothesis. To quote McLean and Urist, "Nor is it suggested that any known chelating agent is present in bone; the possibility is that substances having similar properties may be found in the organism".

Acknowledgements.—I wish to acknowledge thanks to Mr. J. Linder for preparation of the histological section and to Messrs. J. King and A. L. Gallup for the photomicrographs.

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DISCUSSION

Mr. Kramer, in opening the discussion, congratulated the speaker on the very clear way in which he had dealt with the subject of bone structure, and on the excellence of the photomicrographs used to illustrate the lecture. Mr. Kramer pointed out that a knowledge of bone structure should be used as a basis for an understanding of bone behaviour, for it is bone behaviour that is of immediate importance to the practising periodontologist. The impossibility of dealing with all aspects of bone in a single lecture had made it necessary for Mr. Pedler to confine his lecture mainly to one aspect of the subject; this might well be used as a basis for a further lecture in some future session.

Mr. Kramer felt that it should be emphasized that bone resorption was going on throughout the skeleton throughout life, this resorption normally being approximately balanced by new bone formation. Therefore, resorption as recognized in a pathological process was not a new and entirely pathological process, but rather a pathological disturbance of a normal balance. He also thought that, although cementum is only a modified form of bone, it was important to realize the differences in behaviour between these two tissues, and especially the inability of the cementum to initiate any reparative process.

Mr. Kramer concluded by asking Mr. Pedler whether he could indicate which aspects of bone structure or behaviour he felt to be in most urgent need of further study and research for the advance of periodontology.

At the conclusion of the discussion a film on "Gingivectomy by Surgery and Electrosurgery" was presented by Mr. F. E. Hopper, B.D.S., F.D.S. R.C.S., as a casual communication.

Roentgenographic Evidence of Condylar Neck Fracture

The author stresses the need for adequate clinical and radiographical examination of all fractures in the region of the mandibular condyles. Radiographical views should include three views at right-angles, one of which should show both sides simultaneously for comparison of the angle of inclination of the condyle heads. Three suitable views are described which can be undertaken with a dental X-ray machine fitted with a 1-mm. aluminium filter.

1. Lateral or transcranial condyle projection modified after Parma (*Rontgenpraxis*, 1932, 4, 633). A film without screens is supported flat against the face on the affected side. The tube, with pointed cone removed and filter in place, is brought close to the opposite side of the face. The centring point is 1 in. anterior to the external auditory meatus and below the zygoma. The tube is angled up 7°. Exposure 20 Ma. S at 60 KVP.

2. Anteroposterior transorbital condyle projection. A film without screens is placed behind and 3 in. lateral to the neck of the affected side. Its lateral and inferior borders are tilted forwards 20°. The tube, pointer cone on and aluminium filter in, is angulated downwards 30°, centred through the inner canthus of the eye to a point 1 in. below the head of the condyle. Exposure 20 Ma. S at 60 KVP.

3. Superior bregma—gonion projection of both condyles. A 10 in. × 8 in. cassette is laid flat and the patient stretches his head forwards over it and places his chin on it as far forward as he can. The tube is angulated down 50°, and centred in the mid-sagittal plane, so that the ray travels parallel to a line joining the bregma and gonion. Distance 25 in.; 50–60 Ma. S at 70 KVP.—BARTON, E. J. (1955), *Oral Surg.*, **8**, 58.

FISTULÆ OF THE LIPS*

By NORMAN WILD

CASE REPORT

A BOY of 9 years was brought by his grandfather for orthodontic examination. The child presented a unilateral cleft palate and hare-lip, both of which had been closed surgically.

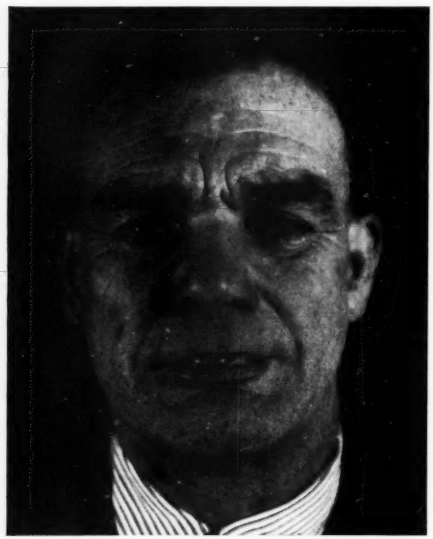
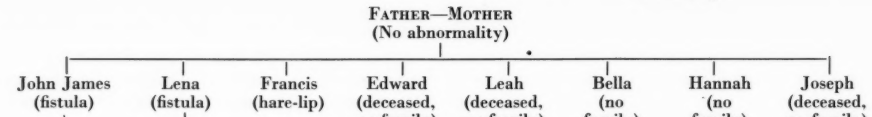


Fig. 1.—Fistula of the lower lip.

Fig. 2.—Fistula of the lower lip with cleft palate and hare-lip.



The grandfather (John James), aged 70 years, was the more interesting, exhibiting a so-called fistula of the lower lip. The clinical appearance was that of a slit or crease running along the crest of the mucosa of the lip (*Fig.* 1), which upon exploration with a blunt probe was seen to contain two fistulæ, each lateral to the median line. When the man's attention was drawn to the condition, he readily gave details of his family, which are shown in the chronological table below.

It was possible to obtain photographs of the man's daughter (Nellie Yvonne), being the mother of the aforementioned child, also presenting a fistula of the lower lip in association with a congenital cleft palate and hare-lip (*Fig.* 2). The clinical appearance of the fistula differed from that of her father in that it was mammilated, having a circular depression surrounded at its circumference by a slight thickening of the mucosa.

Some difficulty was experienced in measuring the true depth of the fistulæ owing to the inability of the patients to relax the lips completely. The depths were in the man approximately 1·0 cm. and 0·8 cm., and in the woman approximately 1·0 cm.

* Read at the meeting of the British Society for the Study of Orthodontics, March 12, 1956.

DISCUSSION

The condition of fistula of the lip is not uncommon (Thoma, 1954), it first being described by Demarquay over seventy years ago, and more recently by Matthews (1942), who reported on 2 such cases seen in the same family. The fistulæ are seen more frequently in the lower lip than the upper lip, and may occur either bilaterally or unilaterally.

The aetiology of the condition is somewhat obscure, although it would appear that in some cases there is an hereditary background. A theory of its causation is that there is an imbalance in growth of the embryonic lip. Where the condition is observed in the lower lip, it has been suggested that there is an excess of growth of the median part of the lip which is separated from the mandibular process by the lateral groove. The excessive growth forms an invagination of the tissues which results in the anomaly. In the upper lip the fistulæ occur at the junction of the globular and maxillary processes, and it has been suggested that excessive growth takes place in the globular process, again causing an invagination of the embryonic mucosa. There is generally a secretion from these openings, which in the cases under discussion was observed to be more pronounced during mastication.

Histopathological findings reveal a narrow tract lined with stratified squamous epithelium extending to and sometimes into the orbicularis oris muscle, thus forming a cul-de-sac into which ducts from adjoining labial glands secrete both mucous and serous products.

Treatment.—Two methods have been suggested:—

1. Complete excision of the epithelial tract, including the associated glandular tissue.

2. Electrocoagulation, the cautery destroying both the glandular tissue and the epithelial lining.

No reports are to be found on the post-operative appearance of these areas.

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A BUCCAL TONSIL

By **A. E. W. MILES**, F.D.S., L.R.C.P., M.R.C.S.

Department of Dental Pathology, The London Hospital Medical College

THE subject of this communication is a nodule of lymphatic tissue in the substance of the cheek mucosa of an adult. In her account of the "tonsillic ring" Cooper (1948) mentions collections of lymphoid tissue embedded in the cheek and employs the term "buccal tonsil", a term which implies that the collections are situated in the mucosa of the cheek. No other description of a "buccal tonsil" has come to my notice and a search of the literature reveals no general belief in the existence of lymphatic tissue in this situation.

The specimen was derived from the cheek mucosa of a man aged 50 who presented with a chronic inflammatory swelling of the left cheek. Centred about 1 cm. below and in front of the orifice of the parotid duct was a mobile nodule about 1 cm. in diameter producing an elevation of the mucosa, at the centre of which was a small opening discharging pus. The opening admitted about 0·5 cm. of a blunt probe. The mucosa of both cheeks presented a number of prominent sebaceous glands.

The nodule was excised and fixed in formol-saline. Serial sections stained alternately with hæmatoxylin and eosin and van Gieson show the nodule to consist of an aggregation of lymphatic tissue grouped around a crypt opening on to the surface of the mucosa and lined with surface epithelium. The lymphatic tissue contains a large number of germinal centres with pale central portions surrounded by more deeply stained peripheral zones

consisting of tightly packed lymphocytes. The germinal centres contain many neutrophil and a few eosinophil leucocytes. Very few mitotic figures are to be seen. The lymphatic tissue is invested closely with a thin capsule of connective tissue, from which a delicate network of reticulin fibres extends between and around the germinal centres. A few reticulin fibres are present among the cells of the germinal centres, but not in their central portions. (*Figs.* 1, 2.)

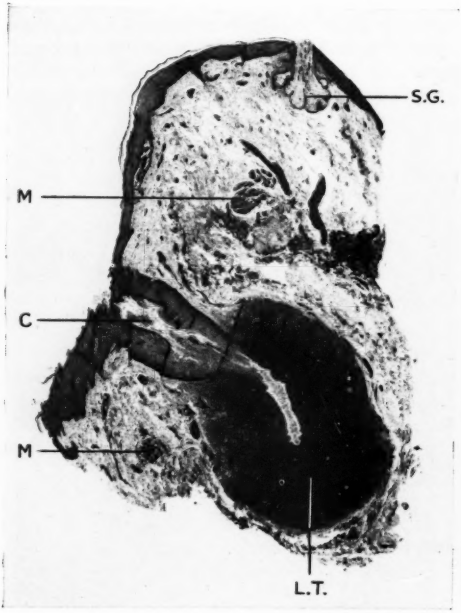

Fig. 1.—Section of tissue containing nodule of lymphatic tissue. C, Crypt lined with surface epithelium; L.T., Lymphatic tissue; M, Muscle strands; S.G., Sebaceous gland. Stained hæmatoxylin and eosin. (× 13.)

Fig. 2.—Higher power view of lymphatic tissue. C, Base of crypt; Ep., Epithelium of crypt; G.C., Germinal centres. (× 91.)

DISCUSSION

Examination of the cheek mucosa in five serially sectioned human embryos (90–154 mm. C.R. length) failed to show the presence of lymphatic tissue. Lymphatic tissue might well, of course, develop in this situation in later fœtal stages. Sections, some in short series, were examined of strips 0·7–2 cm. in length of human cheek mucosa from 17 autopsy subjects ranging in age fairly evenly between 23 and 65 years. Sections of two similar specimens from children aged 3 and 9 years were also examined. No lymphatic tissue was found, but inflammatory cells of various types either diffusely dispersed or in small aggregations in the lamina propria were not uncommon, particularly in relation to the ducts of sebaceous and mucous glands. None of the aggregations was encapsulated, however, nor contained germinal centres.

The lymphatic tissue of the upper part of the pharynx tends to be diffusely distributed and it is reasonable to expect that lymphatic tissue normally confined to the mucosa of the lateral wall of the pharynx might occasionally develop ectopically in the nearby cheek mucosa.

Poirier and Cunéo (1909), in discussing the lymph-nodes of the face, say: "Tous ces ganglions buccinateurs sont placés au-dessus

de l'aponévrose buccinatrice. Debierre signale cependant l'existence possible de ganglions sous-aponévrotiques. Poncet aurait même rencontré un ganglion sous-muqueux."

The original source of this statement that Poncet encountered a submucous lymph-node has not been traced with certainty, but Vigier (1892), in a paper dealing with inflammatory conditions of the lymph-nodes of the face, mentions Poncet in connexion with his description of a woman aged 46 years with two inflamed nodules immediately under the buccal mucosa. These nodules are referred to as lymph-nodes, although no histological examination was made.

As may be inferred from the above quotation from Poirier and Cunéo, lymph-nodes are not uncommon on the lateral aspect of the buccinator muscle along the course of the anterior facial vein. The possibility of the present specimen being a buccinator lymph-node that had come into communication with the cheek mucosa as a result of infection and consequent suppuration has received consideration, particularly in view of the fact that the specimen is related to a few strands of striated muscle. In such a case the crypt lined with epithelium could be explained on the basis of the epithelialization of a suppurating sinus. There is, however, no doubt that the nodule was situated in the submucosa and did not extend through or into the substance of the buccinator muscle.

According to Maximow and Bloom (1952) "new foci of lymphatic tissue and even lymph-nodes can develop in any part of the loose connective tissue in the adult organism. When this happens, the lymphocytes and the elements of the stroma develop from the ubiquitous undifferentiated mesenchymal elements of the adult connective tissue". This statement appears to be based upon the fact that lymphatic tissue with germinal centres is sometimes found in unusual situations, usually in association with chronic inflammatory conditions; for example, Jacoby (1927) described lymphatic tissue in the kidney parenchyma and renal pelvis in pyelonephritis in man, and refers to the experimental production of lymphatic tissue in the kidneys of dogs and cats by the injection of turpentine. Furthermore, according to Bennett (1949) germinal centres may develop in the focal collections of lymphocytes in synovial villi in rheumatoid arthritis in man. It would therefore appear remotely possible that the specimen described here arose in the manner described by Maximow and Bloom at a site of chronic inflammation in the cheek mucosa.

SUMMARY

A specimen from the cheek mucosa with the structure implied by the term "buccal tonsil" is described. The rarity of lymphatic tissue in this situation is established by an examination of the literature and of specimens of human cheek mucosa. Two possible explanations of the occurrence of the "buccal tonsil" are offered: (1) that it is an ectopic fragment of pharyngeal lymphatic tissue; (2) that it developed as a new formation at a site of chronic inflammation of the mucosa.

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Space Control

Although the mesiodistal width of the two premolars is less than the corresponding measurements of their predecessors, it is fallacious to argue that the first permanent molar can therefore be allowed to drift forward a few millimetres without crowding the premolars. It must be remembered that the permanent canine must also be accommodated, and that this tooth is considerably wider than the deciduous canine. The design and use of the removable space maintainer is discussed.—GAINSFORTH, B. L., *J. Dent. Child.* (1956), **22**, 188.

ABSTRACTS FROM OTHER JOURNALS

Newer Knowledge of Salivary Gland Physiology

Research indicative of a relationship between the salivary glands and other body tissues is not much in evidence in dental literature. This paper reviews them briefly.

Ginn and Volker reported that removal of the glands of the albino rat at weaning, and subsequent maintenance on milk diet plus copper, iron, and manganese resulted in reduction in growth rate together with rusting of the fur.

Higashijo found that similar gland removal and ligation of the parotid duct resulted in hypertrophy of the uterus of young female rats and atrophy of the testes of the male.

Barker and Schwartz reported that the salivary glands are among the tissues of the body where energy metabolism is controlled by the thyroid gland.

Faucett and Kirkwood said that next to the thyroid gland the salivary glands contain the greatest amount of the enzyme tryosine iodinase. They reported that these glands function as reverse thyroids in that they degrade organically-bound iodine compounds.

Muhler and Shafer found that the addition of desiccated thyroid to a caries-producing diet reduced caries in the rat to the same degree as sodium fluoride ingestion.

From the foregoing researches it is apparent that the salivary glands have some direct relationship with the thyroid and an indirect one with the gonads, and that these associations may have some influence on dental caries attack rates. VOLKER, J. F. (1955), *J. Canad. dent. Ass.*, **21**, 569.

The Movability of Vital and Devitalized Teeth in the Macacus Rhesus Monkey

Endodontic therapy was performed on the anterior teeth on the left side of the upper and lower jaws of two animals. For the maxillary teeth the root-canal filling was gutta-percha in conjunction with Kerr root canal seal and for the mandibular teeth the silver point technique was employed. Precise asepsis was practised. Three weeks elapsed between the completion of the endodontic procedures and the fitting of bands for the edgewise technique. At that point the control animal was sacrificed. Round steel archwires of 0·018 in. diameter were used and coil springs exerted a force of 2 oz. upon vital and devitalized teeth. Once a week the appliances were adjusted. The first animal was sacrificed after six weeks of orthodontic treatment and the second animal after eight weeks. From the second animal four first premolar teeth had been extracted. The decalcified tissue was stained in hæmatoxylin and eosin and 120 slides were made. The histologic findings differed in certain respects from the results of other workers and it is suggested that this is due to the precise control achieved in this experiment by the use of the edgewise technique. Under the conditions of this experiment on a macacus rhesus monkey there is no difference between orthodontically moved vital and devitalized teeth. No indication of a foreign body reaction was found at the apices of the devitalized teeth.—HUETTNER, ROBERT J., and YOUNG, ROBERT W. (1955), *Amer. J. Orthodont.*, **41**, 594.

The Rates of Growth of Several Facial Components Measured from Serial Cephalometric Roentgenograms

An investigation was undertaken utilizing serial cephalometric roentgenograms of 15 white persons. The study covered an age range of 4 to 20 years, and at least twelve roentgenograms were available for each subject. Each series of roentgenograms was studied in terms of curve of growth and curve of relative increment. The growth curves of all the facial dimensions were typical of general skeletal growth. The curve for sella-nasion is a composite of neural and general body growth. Those of nasion-prosthion and infradentale-gnathion are modified in childhood by the transition from deciduous to permanent dentition. At puberty there is a general increase in the rate of growth. The time of both the onset

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Including the official reports of the British Society of Periodontology, the British Society for the Study of Orthodontics, the European Orthodontic Society, the Liverpool and District Odontological Society, the North Staffordshire Society of Dental Surgeons, the Odonto-chirurgical Society of Scotland, and the Dental and Medical Society for the Study of Hypnosis

VOL. VI, NUMBERS 1–12 SEPTEMBER, 1955–AUGUST, 1956

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and the peak of the rate of growth for the various dimensions of the same child are different—that is, the form of the face is of necessity changed. Body height completes its growth sooner than the face. In the small sample studied, girls showed relatively less facial growth than the boys during adolescence. —NANDA, R. S. (1955), *Amer. J. Orthodont.*, **41**, 658.

"Crazing" of Acrylic Resin

"Crazing" is the term given to the appearance of small surface cracks often observed in dentures and teeth of acrylic resin. The investigation reported in this paper, shows that "craze" susceptibility is dependent on variations in processing procedure. Tests with various investigating media showed that differences in thermal expansion of these media are not major factors in crazing.

When linear methyl methacrylate comes in contact with water during processing at elevated temperatures, "crazing" occurs. This does not happen if the material is protected from water. The authors advance the theory that sorption of excess water at elevated temperatures causes the surface of the material to be super-saturated with water when the specimen is cooled. Evaporation of the excess water sets up strains which are released by the formation of "craze" marks.—SWEENEY, W. T., BRAUER, G. M., SCHOONOVER, I. C. (1955), *J. dent. Res.*, **34**, 306.

A Shoulder Preparation and Veneered Gold Jacket for Fractured Young Vital Permanent Incisors

A labial shoulder can be prepared on a young incisor without injuring the pulp tissue, and on this assumption, the preparation of a jacket crown is described which is claimed to be more æsthetic than previous types of restoration.—NORMAN, M. A. (1956), *J. Dent. Child.*, **22**, 167.

LETTER TO THE EDITOR

July 7, 1956.

Dear Sir,

We would like to comment on the article "Repairing Mesial Denture Fractures" which appeared in your June issue.

It is assumed that Mr. Willmott is in fact referring to midline fractures, and we wish to make the following points:—

1. His reference to plastic posterior teeth is timely, as we have been advocating the use of porcelain posterior teeth at this School for some years.

2. With regard to the repair technique, Ware and Docking (1950), have shown that polished rounded edges produce a repair of greater strength than rough or sharp ones.

3. The union of the new and old materials is due to monomer passing into the already polymerized denture base, and, when processed, chemically bonding the materials. There is no question of lack of cohesion or "edges rolling up" if the correct technique is used.

4. It has already been emphasized by Leader and Pearson (1952) and Tyldesley (1952) that metal inserts do not strengthen the denture, the explanation being that the discontinuities increase the stress concentration. (Matthews and Wain, 1956.)

Strengthening of an acrylic resin upper denture may be achieved by the use of fibreglass (Leader, 1952), and by thickening the resin denture base behind the anterior teeth as is done when porcelain anterior teeth are used.

It is felt that before articles of this nature are submitted, consideration should be given to previously published work, and adequate reference made to the literature.

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— — and PEARSON, R. W. (1952), *Ibid.*, **92**, 179.
MATTHEWS, E., and WAIN, E. A. (1956), *Ibid.*, **100**, 167.
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WARE, A. L., and DOCKING, A. R. (1950), *Aust. J. Dent.*, **54**, 27.

Yours sincerely,

J. F. BATES
A. S. T. FRANKS

Turner Dental School,
Manchester, 15.

EXAMINATION RESULTS

ROYAL COLLEGE OF SURGEONS OF ENGLAND
July, 1956

Licentiate in Dental Surgery:—The Board of Examiners in Dental Surgery reported to the Council that, at the recent Final Examination for the Licence in Dental Surgery, 74 candidates were examined by the Surgical Section of the Board and 105 by the Dental Section. Of these candidates 53 were approved by the Surgical Section and 77 were approved by the Dental Section.

The Board found that 75 candidates, having fulfilled the requirements of both Sections of the Board, were qualified to receive their Diploma. The Board, therefore, recommended that the Diploma of Licentiate in Dental Surgery be granted to the following 75 candidates:—

Adey, J. W.; Andrew, Shirley Irene; Appleby, J. D.; Baker, R. I.; Bell, Jennifer Brattan; Bickler, H. R.; Biggs, J. E.; Boyle, W. M.; Brown, Ann Latham; Brown, D. M.; Brown, J.; Capstick, F. A.; Chaudhury, P. K.; Churney, R.; Coe, R. C.; Collier, M.; Crabtree, N. L.; Davies, P. L.; Dewan, M.; Domb, R. R.; Doughty, J. F.; Duggal, B. L.; Erridge, P. L.; Everett, A. D.; Field, W. R.; Foster, B. C. R.; Galtung, Mona; Gerroll, M.; Gilbert, J. W.; Grant, A. J. K.; Grant, L.; Hepburn, J. W.; Higginbottom, H. R.; Imrie, C. K. M.; Keen, J. A.; Kennedy, D. E.; Kennedy, D. C.; Knight, H. H.; Lee, G.; Lindsay, M. J. R.; McCarthy, J. R.; Metzger, R. E.; Middleton, D.; Minton, J. E.; Moss, J. H.; Moyse, R. C.; Murray, June Patricia; Parker, C. B.; Parry, P. N.; Patel, J. M.; Patwardhan, S. V.; Pearce, D. H. M.; Perkins, Monica Renée; Preston, J. E.; Richardson, Mavis Anne; Ricketts T. H.; Roy, R. K.; Rylance, J. F. H.; Sadler, J. B.; Shamia, R. I.; Simmons, L. H.; Smith, G. E.; Smith, J. A. J.; Smith, T. H.; Stammers, D. J. F.; Stamp, D. C.; Sunderland, P.; Swinn, B. P.; Taylor, E. J.; Thakrar, L. B.; Thomas, V. B.; Tomlinson, T. B.; Wardle, T. R.; Wickers, J. H.; Wilcockson, B.

UNIVERSITY OF LIVERPOOL
June, 1956

Degree of Bachelor of Dental Surgery (*Final Examination, Part I*):—

Edmondson, Margaret N.

Licence in Dental Surgery (*Final Examination, Part I*):—

Hudaly, S. I. T.

Degree of Bachelor of Dental Surgery (*Third Examination, Part II*):—

Cunliffe, J. J.; Danchin, N.; Jenkins, Ruth G.; Llewellyn, R. L. (with distinction): MacConnachie, H. F.; Vega, G. A.

Licence in Dental Surgery (*Third Examination, Part I*:)—

Carling, W. H.; Connor, V. A.; Cooper, M. W.; Coyle, P. R. W.; Crookall, R. F.; Davies, W. B.; Downer, M. C.; Dyer, J. L.; Hernaes, Ingrid K.; Holland, Pamela M.; Powell, F.; Rader, A.; Williams, H. R.; Wookey, C. P.

Degree of Bachelor of Dental Surgery (*Second Examination, Part I*):—

Williams, B. P.

Licence in Dental Surgery (*Second Examination, Part I*:)—

Aspestrand, R. G. (a, b); Bowe, T. (a, b); Brunvand, E. (b); Farmer, D. J. (a, b); Kennedy, Marie P. (a, b); McCarthy, Sheelagh, F. (a, b); Sandham, J. (a, b); Thomas, W. (a, b); Williamson, J. E. (a, b).

(a) Anatomy; (b) Physiology.

Licence in Dental Surgery (*Second Examination, Part II (a)*):—

Connor, V. A.; Dyer, J. L.; Farrington, D.; Love, P. S.; Smith, H.; Warner, Marie A.; Williams, H. R.; Wookeg, C. P.

Licence in Dental Surgery (*Second Examination, Part II (b)*):—

Clegg, J. H.; Coyle, P. R. W.; Kent, R. F.; Love, P. S.; Noar, G. A.; Smith, H.; Warner, Marie A.

Licence in Dental Surgery (*Second Examination, Part II (c)*):—

Clegg, J. H.; Davies, W. B.; Dyer, J. L.; Petty, R.

Degree of Bachelor of Dental Surgery (*First Examination*):—

Berman, B. (b); Foulkes, G. E. (b); Gould, M. (a, b); Leyland, M. J.; (a) Morton, D. J. (b); Powell, Irene (b); Si, M. B. (a, b); Vautier, Dorothy (a); Wall, B. (a).

(a) Chemistry; (b) Physics.

UNIVERSITY OF DURHAM
June, 1956

Degree of Bachelor of Dental Surgery (*Final Examination*):—

Angus, D. A.; Arnheim, Miss E. E.: Black, Miss B. H.; Blight, Miss J.; Bloch, W. W.; Breakey, L. F.; Brown, Miss A. E. M.; Carter, H. R.; Casartelli, J. V. P.; Davidson, D. P.; Ebrahim, I. A.; Ellerton, D. A.; Foreman, P. C.; Gibbs, Miss L. Y.; Graham, G. S.; Grainger, J.; Haddon, R. M.; Hatimi, H. A.; High, E. A.; Hopkins, R.; Isaac, D. G.; Kanagaraja, S.; Lawson, G.; Lodge, B.; Long, G. C. J.; Mason, Miss J.; Murray, I. D.; Norris, H. D.; Onwurah, M. O.; Paterson, A. K.; Phillips, D. G.; Phillips, M. E.; Playford, J. V.; Quinn, Miss M. P.; Reece, J. W.; Rigby, F. R.; Sinclair, N. F. C.; Stewart, Miss N. S.; Symington, J. M.; Thompson, J. H.; Wise, A.

Degree of Bachelor of Dental Surgery (*Final Examination, Part I*):—

Back, D. C.; Bell, M. H.; Birch, R. V.; Bloom, B. W.; Brown, Miss H. M. C.; Calow, Miss D. E. M.; Catchside, J.; Chadwick, I.; Collins, Miss M.; Crosbie, B. W.; Davies, G. N.; Ellis, P. M.; Elves, G.; Forehead, D. R.; French, M. S.; Frønman, S.; Geffner, I., Glenwright, H. D.; Golding, Miss K. M.; Gooder, M. E.; Goodley, A. K.; Green, H. E. B.; Johnson, Miss S.; Khan, S. A.; Lewis, D. R.; Lindsay, D. M.; Lord, Miss M.; Molloy, J. K.; Moodaley, S. N.; Moss, B.; Nand, R. M.; Padayachy, P. N.; Park, I. T.; Plummer, K. E.; Prempeh, G. O.; Priestley, P. J. M.; Richardson, M. C.; Robson, P. S.; Rouse, W. M.; Sheard, M. J. R.; Taylor, V. E.; Thompson, H.; Thompson, R.; Wainstein, I. L.; Walton, Miss H. M.; Wilson, D.; Wimaladharma, W. G.

Licence in Dental Surgery (*Final Examination*):—

Bell, M. D. E.; Bhinda, S. V.; Daniels, T. G.; Foulds, R. M.; Javid, B.; Pascal-Murray, H. F.; Rothwell, R. M.; Taylor, A. C.; Wrigley, P. C.; Yee-Chong, H.

Licence in Dental Surgery (*Final Examination, Part I*):—

Henshaw, N. E.; Solan, J.

Degree of Bachelor of Dental Surgery (*Fourth Examination*):—

Aaron, R.; Bancroft, G. H.; Bluck, D. R.; Charlton, G.; Clark, A. M.; Clucas, R.; Dewell, D.; Etherington, Miss L.; Gough, N. G.; Harrison, T. D.; Howlett, R. A. N.; Hunter, J. B.; Ipakchi, A. H.; Marshall, G.; Morgan, A. R.; Neden, Miss J.; Neverlien, P. O.; Redhead, P. A.; Ridley, T. J.; Rowlay, Miss R. A.; Serfontein, D. D.;

Spencer, J.; Stubbs, J. M.; Vorster, S. W.; Wallace, J. D.

Licence in Dental Surgery (*Fourth Examination*):—

Christelis, A.; Ferrell, R. S.; Harper, M. J. G.; Joyce, M. W.; Levin, H.; Naru, B. S.; Newman, E. H.; Nirsimloo, P. C.; Pepple, Miss G. A.; Rosser, O.; Rosen, M.; Rothfield, J. S.; Widdicombe, J. R.; Wold, K. O.; Wright, E. B.

Licence in Dental Surgery (*Fourth Examination, Part I*):—

Forster, P. E.; Selby, G. K.; Smith, T. O.

Degree of Bachelor of Dental Surgery (*Third Examination*):—

Allan, W. C.; Carapeti, S. A.; Carruthers, J. S.; Carter, J. E.; Caulker, S. G. B.; Danjoux, A. R.; Drury, W. J.; Elston, C. S.; Fairpo, C. G.; Greenburgh, R. L.; Heward-Mills, S. D.; Hutchinson, P. D.; Johnson, D. B.; Koranteng, L. O.; Lang, D. G. E.; Mokrzycki, J.; Safinia, F.; Simpson, M. W.; Sockett, M.; Teasdale, J. W.; White, P.; Willis, P.

Licence in Dental Surgery (*Third Examination*):—

By, R.; Eriksen, T. E.; Funderud, Miss T.; Hagen, K.; Hardy, E. G.; Henriksen, Mrs. B.; Henriksen, E. O.; Hjardeng, H. V.; Jack, P. I.; Kvaale, Miss T.; Kvindesland, P. K.; Loe, L. E.; McMeekin, P. A.; Morrison, J. K.; Mortensen, R. M.; Naidoo, R.; Rabinowitz, J.; Rasmusson, T. H.; Robinson, B.; Rogstad, S. B.

Degree of Bachelor of Dental Surgery (*Second Examination*):—

Ana, J. R.; Baglee, M. S.; Barker, D. B.; Barnett, J. E.; Broady, Miss S. A.; Carr, J. M.; Chalk, Miss S. I.; Cloete, J. G.; Cooper, Miss P. L.; Coote, J. D.; Dacre, J. T.; Dewhurst, Miss M. M.; Egan, J. F.; Fawcett, P. E; Fox, I. G.; French, A. E.; Haworth, Miss G.; Hedley, W.; Hilton-Bailey, I.; Humphreys, J. R.; Jacks, A. M.; Jackson, R. A.; Jones, B. J.; Jones, B. L.; Kenyon, F. A.; Lifschitz, M.; Longstaff, W. R.; Miller, B.; Molloy, Miss D.; Priestley, M. S.; Rimer, J. D.; Sausby, P. E.; Tate, J. M.; Wilkes, T. A.; Wilson, G. E.

Licence in Dental Surgery (*Second Examination*):—

Baldwin, A. T.; Berrystone, Miss E. M.; Danbolt, N. N.; Davies, J. R.; Feinberg, L. T.; Fraser, B. M.; Garsrud, O.; Hassel, H. S.; Haust, G.; Hoidahl, O. A; Hugaas, D. A.; Julsvoll, B. N.; Khin, M. L.; Manderson, R. D.; Morrissey, R. A.; Nunn, C. W.; Padayachee, D. N.; Pettersen, O. H.; Pickford, T. B.; Preston, Miss G. A.; Proctor, J. N.; Rutherford, O. H.; Pickford, T. B.; Preston, Miss G. A.; Proctor, J. N.; Rutherford, Miss A.; Short, Miss M. K.; Stormo, K.; Svanaes, D.; Ward, J. M.

Degree of Bachelor of Dental Surgery (*First Examination*):—

Brown, A. J.; Clinton, S. G. J.; Foster, W. J.; Jones, M. G.; Lee, B. M.; Morgan, W. G. D.; Morley, G. D.; Mustard, A. S.; Naylor, J.; Peters-Jones, W. R.; Pritchard, H. W.; Smart, E. R.; Stephens, Miss S. A.; Storey, D. P.; Torz, W.; Vallender, R. C.

Licence in Dental Surgery (*First Examination*):—

Berstad, R.; Brennan, Miss M.; Carreras, Miss E. C.; Cohen, H. I.; Duffy, Miss J.; Griffiths, Miss R. E.; Hafsmo, L.; Hegbom, A.; Holstad, K.; Johannesen, B.; Kornitzer, P.; Kristensen, H. K.; Kvakestad, T. A.; Midttun, O.; Nordmo, P. M.; Oliver, R. B. W.; Refson, B.; Robinson, A.; Robson, R. G.; Rodmell, M. J.; Spetalen, E.; Sundby, D.; Watson, G. A.; Wilson, J.

UNIVERSITY OF EDINBURGH

July, 1956

Degree of Bachelor of Dental Surgery (*Final Examination*):—

Armitage, Jean Elizabeth; Armitage, J. S.; Biggin, D. R.; Campbell, I. J.; Davies, D. B.; Hitti, E. D.; Kjelland, C. H.; Macdonald, J.; McKendrick, A. J. W.; Simpson, W.; Smith, D. H.; Solomon, G. R.; Thom, W. M.; Thomson, N. P.; Tyson, K. W.; van der Merwe, H. R. A.; Willacy, R. A. W. (with distinction).

UNIVERSITY OF GLASGOW

July, 1956

Degree of Bachelor of Dental Surgery:—

Alexander, G. I. C.; Barnett, M.; Blass, J. M.; Brownlee, T. N.; Colquhoun, N. K. (with commendation); Duthie, J. L.; Eadie, R. W.; Felstein, A.; Fisher, D. N. L.; Frame, R. L.; Harris, W. S.; Kelly, P. A.; Kinghorn, W. A.; McIlraith, G. R.; Mackay, D. L.; McNicol, J. A.; Martin, J. S.; Narrowmore, M. K.; Page, V. Ll.; Pearce, H. M.; Roynstrand, T.; Tait, J. S.; Thomson, M. D.; Urbye, K. S.; Wood, R.

BOOK REVIEWS

PRACTICAL ORTHODONTICS. Original text by the late MARTIN DEWEY. Eighth edition revised by GEORGE M. ANDERSON, D.D.S., formerly Professor of Orthodontics, Baltimore College of Dental Surgery, Dental School, University of Maryland. $9\frac{3}{4} \times 6\frac{5}{8}$ in. Pp. 702 with 719 illustrations. 1955. London: Henry Kimpton. £6 10s.

THIS is the latest edition of the text known for so long as " Dewey and Anderson ". In the edition of twenty years ago (when the word was orthodontia) the preface stated "This text is wedded to no one idea or system". That is where its strength lies. For more than forty years this book has made a contribution to dental education and its continuing success is due to the thoroughness with which each revision has been carried out. There is little fault to find with the choice of new material included and none of the omissions will be regretted. An exception to these remarks is the chapter on plastic surgery of the jaws. Apart from its cephalometric aspect the section of dental radiography might well be omitted. The subject is fast becoming a speciality in its own right. One cannot read the book without being impressed by the sound judgement the author brings to bear upon the many problems in orthodontics. A little more might have been said about the

significance of the freeway space and about the behaviour of the tongue and lips in swallowing. The alleged effects of atmospheric pressure are discussed, although muscle imbalance would seem adequate explanation of the malocclusions associated with open mouth-breathing. Bibliographical references are full but appear at the bottom of the page.

J. S. B.

"THIS WON'T HURT A BIT". The Musings and Memories of a Dental Surgeon. By HADDON ROWAT. With a Foreword by Professor J. C. MIDDLETON SHAW. 8½ × 5½ in. Pp. 141 + viii, with 2 plates. 1956. Bristol: John Wright & Sons Ltd. 12s. 6d.

THE sub-title of this book is "the musings and memories of a Dental Surgeon". It begins in the dark ages of dentistry, or, as the author calls them, the "bad old days", of about fifty years ago. It is quite extraordinary to realize some of the conditions under which dentistry was practised in those days. The book is the autobiography of a man who saw dentistry grow up and has personally experienced the bizarre and notorious in dentistry as well as its finer side. His view of dentistry extends across the seas as well as the years and through two world wars. The book will interest all the members of the dental profession, although his philosophy may not please everybody; but then no one man's view will appeal to all. His opinions range over all aspects of world dentistry and prove that there is plenty of adventure in dentistry for those who seek it.

N. L. W.

DENTAL ABSTRACTS. Published monthly by The American Dental Association, 222, East Superior St., Chicago, Illinois. Yearly foreign subscription $7.00.

THE American Dental Association commenced publication in January, 1956, of a monthly journal with the title *Dental Abstracts*, a selection of world dental literature. It is divided into the following sections: orthodontics, oral surgery, professional activities, basic science, periodontics and endodontics, operative dentistry, prosthetic dentistry, preventive and public health dentistry, armamentarians, and instrumentarians.

The production, edited by Lon W. Morrey, is well illustrated on good quality paper, with clear indexing of contents and authors. It presents a very wide and comprehensive selection of the published dental literature of all countries, and as such will fill a long-felt need for those who wish to keep abreast of the latest advances in dental science and practice.

D.F.S.

NATIONAL HEALTH SERVICE NOTES

Professional and Technical Whitley Council "B"

Dental Technicians

P.T.B. Circular 59 introduces a new definition for Senior Technician, a new grade of Senior Technician (Surgical)-in-Charge and new provisions for counting service prior to entry into the Health Service.

1. The provisions of P.T.B. Circular 59 have been approved by the Minister of Health under Regulation 3 of the National Health Service (Remuneration and Conditions of Service) Regulations, 1951 (S.I. 1951 No. 1373), and employing authorities have been asked to put them into effect.

2. If any dental technician within the scope of the circular decides under paragraph 6 to remain on his non-Whitley salary and conditions of service, Boards and Committees have been asked to notify the Management Side Secretary.

DENTAL RADIOGRAPHY

A two-day course in dental radiography has been arranged for dental nurses and assistants, to take place on Thursday and Friday, September 13–14, 1956, at the Ilford Limited Department of Radiography and Medical Photography, Tavistock House North, Tavistock Square, London W.C.1.

Lectures will be given in the mornings from 10.0 a.m. to 12.30 p.m., and in the afternoons from 2.0 to 3.0 p.m. The rest of the time until approximately 4.0 p.m. will be devoted to practical demonstrations given on the X-ray units and in the darkrooms.

No fee is charged for this course. Application forms will be sent on request.

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VOLUME VI, Nos. 1–12 (SEPTEMBER, 1955—AUGUST, 1956)

THE DENTAL PRACTITIONER and DENTAL RECORD

VOL. VI, NO. 12 AUGUST, 1956

Including the official reports of the British Society of Periodontology, the British Society for the Study of Orthodontics, the European Orthodontic Society, the Liverpool and District Odontological Society, the North Staffordshire Society of Dental Surgeons, the Odonto-Chirurgical Society of Scotland, and the Dental and Medical Society for the Study of Hypnosis

CONTENTS

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CORK DENTAL HOSPITAL (North Infirmary). The Committee of Management invite applications from suitably qualified persons for the post of FULL-TIME DIRECTOR of Cork Dental Hospital and School. Salary £2,000 per annum. Contributory Pension Scheme available. Further information may be had from the Hospital's Secretary.

Applications, stating age, qualifications, administrative and teaching experience, with the names of three referees, should reach the undersigned not later than 11 a.m. on Tuesday, September 11, 1956.

D. Buckley, Secretary.

DENTAL TECHNICIAN holding final "City and Guilds" certificate and experienced in orthodontic, with some knowledge of gold work, seeks position with dental surgeon in Midlands. Box No. 146, DENTAL PRACTITIONER AND DENTAL RECORD.

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UNIVERSITY OF WESTERN AUSTRALIA. Applications are invited for the position of SENIOR LECTURER IN ORAL MEDICINE AND SURGERY. The applicant must hold a degree in Dental Science which is registrable by the Dental Board of Western Australia. In addition, he should possess clinical experience either as a specialist in Oral Surgery, or as a general practitioner who has had special experience in this field. It is also desirable that he should possess some teaching experience in the subjects of Oral Surgery and Oral Pathology. The salary range for Senior Lecturers is £A1,850–£A2,150 per annum and the commencing salary will be determined on the basis of the qualifications and experience of the appointee. An allowance is made towards travelling expenses.

Further particulars and information as to the method of application may be obtained from the Secretary, Association of Universities of the British Commonwealth, 36 Gordon Square, London, W.C.1.

The closing date for the receipt of applications, in Australia and London, is September 30, 1956.

COURSES

REFRESHER COURSES for GENERAL DENTAL PRACTITIONERS under N.H.S. (Scotland) will be held in the Edinburgh Dental Hospital twice weekly, on Tuesdays and Thursdays, from 5 to 7 p.m., starting on October 23 and 25, 1956. ORTHODONTICS—eight meetings on Tuesdays; CHILDREN'S DENTISTRY, PERIODONTAL DISEASE AND THE USE OF ANTIBIOTICS—eight meetings on Thursdays.

Applications to the Director, Edinburgh Post-Graduate Board for Medicine, Surgeon's Hall, Edinburgh, 8.

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Continued on page viii . .

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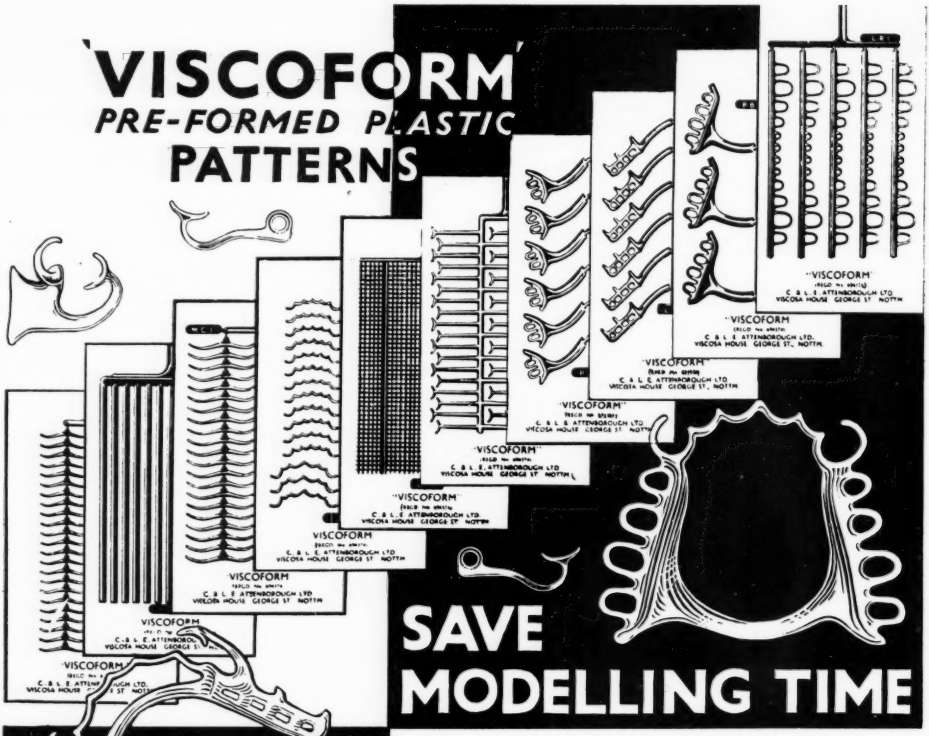

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DURATION OF STUDY	NUMBER OF PATIENTS			CARIES RATE		% Reduction of Caries Incidence by High-Urea Ammoniated dentifrice
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4-year study complete report (2)	185	75	110	2.33	1.31	43.6%
3-year study interim report (5)	120	31	89	2.19	1.08	50.9%
2-year study interim report (1)	60	30	30	1.60	0.96	39.6%

References. 1. Gale, J. A., Dent. Record, 71. 15, 1951. 2. Henschel, C. J. and Lieber, L. Oral Surg. Oral Med. and Oral Path., 5. 155, 1952. 5. Lefkowitz, W. and Venti, V. I. Oral Surg. Oral Med. and Oral Path., 4. 1576, 1951.

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. . . rapidity

Tissutex saves time as it sets quickly in the mouth. Total time for preparation and setting is only 4 minutes.

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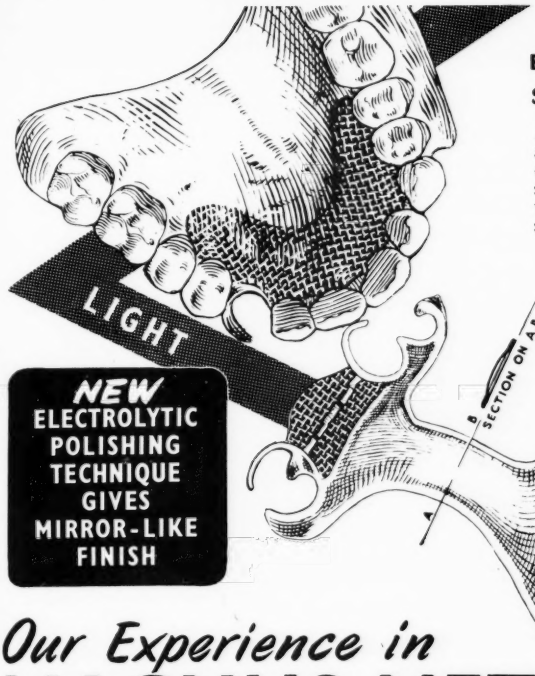

Combined

BAND AND STRENGTHENER

swaged in one piece

A strengthener should be used when the anteriors are gum fitted or when isolated teeth only are present. A Magnus Metal strengthener is an inexpensive, sure, and neat way of avoiding troublesome fractures. As shown, clasps can be integral with it.

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PARTIAL BASE WITH STRENGTHENER

Strengtheners must be used similarly for Magnus Metal bases especially saddle uppers and partial lowers. It is safer to entrust this highly technical process to Attenboroughs, for skill, knowledge, and special equipment are necessary.

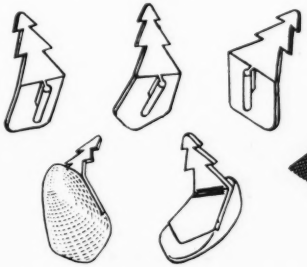
STRONG

ECONOMICAL

Our Experience in

MAGNUS METAL

Technique is your best guarantee of satisfaction for your patients



BACKINGS WITH TAGS

These are a new development in Magnus Metal invaluable for cases with close or heavy bites. For use with porcelain facings primarily, they may be shortened to act as ¾ backings for acrylic teeth.

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Printed and Published by John Wright & Sons Ltd., at the Stonebridge Press, Bath Road, Bristol 4.